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PART IV

# DEPARTMENT OF LABOR

## Occupational Safety and Health Administration

# OCCUPATIONAL EXPOSURE TO ACRYLONITRILE (VINYL CYANIDE)

## Proposed Standard and Notice of Hearing

[4510-26]

Title 29—Labor

CHAPTER XVII—OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, DEPARTMENT OF LABOR

PART 1910—OCCUPATIONAL SAFETY AND HEALTH STANDARDS

**Emergency Temporary Standard for Occupational Exposure to Acrylonitrile (Vinyl Cyanide); Notice of Hearing**

AGENCY: Occupational Safety and Health Administration, Department of Labor.

ACTION: Emergency Temporary Standard: Notice of hearing.

SUMMARY: By this emergency temporary standard (ETS), the Occupational Safety and Health Administration (OSHA) amends its present standard concerning employee exposure to acrylonitrile (AN) (also known as vinyl cyanide) and reduces the permissible exposure level from 20 parts acrylonitrile per million parts of air (20 ppm), as an 8-hour time-weighted average concentration, to 2 ppm, with a ceiling level of 10 ppm for any 15-minute period during the 8-hour day. In addition, the standard includes an action level of 1 ppm as an 8-hour time-weighted average. Provision is also made for specific exemptions in the standard for certain operations involving the processing, use and handling of products fabricated from polyacrylonitrile (PAN). The basis for this ETS is OSHA's determination that laboratory and epidemiological data indicate that continued exposure to acrylonitrile presents a cancer hazard to workers. A grave danger therefore exists for workers exposed to AN, necessitating the issuance of an emergency standard to protect them. In addition, the ETS requires the measurement and control of employee exposure, personal protective equipment and clothing, employee training, medical surveillance, work practices, and recordkeeping. The ETS will be superseded by a permanent standard withing six months. A proposed permanent standard for occupational exposure to acrylonitrile is published elsewhere in today's FEDERAL REGISTER.

DATES: The effective date for this ETS is January 17, 1978. The period for receipt of written data and comments on the proposed permanent standard will run through February 21, 1978. Notices of intention to appear at the informal rulemaking hearing on the proposal must be postmarked by February 27, 1978. Documentary evidence and witness statements for the hearing must be received by March 7, 1978. The public hearing on the proposed permanent standard will commence on March 21, 1978.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION:

I. APPLICABILITY OF EMERGENCY TEMPORARY STANDARD (ETS)

The accompanying document is an emergency temporary standard issued pursuant to sections 6(c) and 8(c) of the Occupational Safety and Health Act of 1970 (the Act) (84 Stat. 1596, 1599; 29 U.S.C. 655, 657), the Secretary of Labor's Order No. 8-76 (41 FR 25059), and 29 CFR Part 1911. The new standard, § 1910.1045, applies to all industries covered by the Act, including "general industry," construction, and maritime.

In addition, pursuant to section 4(b)(2) of the Act, OSHA has determined that this emergency temporary standard is more effective than corresponding standards now applicable to the maritime and construction industries and currently contained in Subpart B of Part 1910, and Parts 1915, 1916, 1917, 1918, and 1926 of Title 29, Code of Federal Regulations. Therefore, those corresponding standards are superseded by the new standard in § 1910.1045.

Pursuant to section 6(c)(3) of the Act, OSHA is commencing a rulemaking proceeding under section 6(b) of the Act, to establish a permanent standard for occupational exposure to acrylonitrile. The proposed permanent standard encompasses those areas of occupational safety and health that are considered appropriate for the permanent regulation of acrylonitrile by OSHA. A hearing is scheduled on the proposed permanent standard, to begin March 21, 1978.

The development of a permanent standard will be conducted pursuant to the rulemaking procedures of section 6(b) of the Act. The Assistant Secretary's decisions on the provisions of the final standard will be based on the entire record developed, including public comments and the informal rulemaking hearing.

II. EVENTS LEADING TO THE EMERGENCY TEMPORARY STANDARD

Occupational exposure to AN is currently limited by the Occupational Safety and Health Administration (OSHA) to an 8-hour time-weighted average of 20 ppm (or approximately 45 mg/m$^3$) as found in Table Z-1 of 29 CFR 1910.1000.

In March 1977, the Manufacturing Chemists Association (MCA) informed OSHA of the interim results after one year of a planned two-year study being conducted by Dow Chemical Co.'s laboratories on the chronic toxicity of ingestion of acrylonitrile by rats. (*3*) Sacrifices of some of the animals after one year showed the development of various tumors, including central nervous system (CNS) and ear canal tumors, among the treated animals, but not among the controls. The tumors were found in animals exposed to 100 and 300 ppm, respectively, in their drinking water. Later reports from MCA, in April, indicated that similar tumors had been found in rats in the lowest exposure group in the test, 35 ppm, and that findings after one year of a continuing two-year study of inhalation of AN by rats noted "comparable" CNS tumors in animals inhaling 80 ppm AN. (*1*)

In May 1977, E. I. duPont de Nemours & Co., Inc. (duPont) informed OSHA of the preliminary results of an epidemiological study demonstrating an excess of cancer among workers exposed to acrylonitrile at a duPont textile fibers plant in Camden, South Carolina. (*5*) For the cohort of 470 workers first exposed to acrylonitrile in the polymerization operation between 1950 and 1955, a total of 16 cancer cases occurred between 1969 and 1975, as compared with 5.8 expected (based on duPont Company rates). Six of the 16 cases were lung cancers (vs. 1.5 expected), three were cancers of the large intestine (vs. 0.5 expected), and the remaining seven were from seven other primary sites. All of the cancer cases occurred among the approximately 350 workers in the cohort who were first exposed to acrylonitrile during the startup of the plant between 1950 and 1952. Although duPont stresses the preliminary nature of these findings, the company did state that when considered in light of the recent animal tests, "(they) raise a serious suspicion that it (acrylonitrile) may be a human carcinogen."

On June 29, OSHA published a request for information on acrylonitrile in the FEDERAL REGISTER (42 FR 33043) (this document was published again in the FEDERAL REGISTER on July 5, 1977 (42 FR 34326)). In this document, OSHA discussed the new information that had been received from MCA and duPont, and requested specific information on various issues relating to occupational exposure to AN. Interested persons were requested to furnish information by July 29, 1977.

OSHA received 25 replies to the request for information, many of which contained considerable data and technical details on the manufacture and use of acrylonitrile, areas of potential employee exposure, and other relevant material. (*9*)

Shortly after OSHA's request for information appeared in the FEDERAL REGISTER, on July 1, 1977, the National Institute for Occupational Safety and

Health (NIOSH) issued a "Current Intelligence Bulletin" on acrylonitrile, outlining the information received from MCA and duPont, discussing the other toxic effects of AN exposure, and recommending interim industrial hygiene practices to be implemented in the workplace to help reduce occupational exposure to acrylonitrile. (*11*)

On September 29, 1977 NIOSH provided recommendations for a revised standard for AN. A permissible exposure level of 4 ppm AN in air as determined by a 4-hour sample collected at a rate of 0.2 liter/minute was suggested. This recommendation was based on what NIOSH considered to be the current analytic limits of the air measurement technique. (*12*)

A more recent communication from NIOSH dated December 7, 1977 said that "(a)lthough the preliminary results of the duPont epidemiologic study are inconclusive by themselves . . ., when viewed in light of the preliminary rat data the conclusion with regard to acrylonitrile is clear—the chemical must be viewed as a proven animal carcinogen and suspect human carcinogen. To do otherwise would be to place the health of exposed workers in jeopardy until more conclusive evidence ultimately surfaces." (*13*)

### III. Reasons for the Emergency Temporary Standard

The Assistant Secretary finds that exposure to acrylonitrile poses a grave danger to humans. This finding reflects the results of the MCA animal studies (which clearly show that acrylonitrile is carcinogenic in animals), and the preliminary results of the duPont human epidemiological study.

The MCA studies show that malignant CNS tumors have been induced in rats by acrylonitrile at all dose levels by the oral route (35, 100, and 300 ppm), and thus far at 80 ppm by the inhalation route. Benign tumors of the stomach were found at the two high-dose levels in the ingestion study (i.e., 100 ppm and 300 ppm) and are also clearly related to the administration of acrylonitrile. Furthermore, the animal studies indicate that AN induces at least two different types of neoplasm in test animals. The interim results of the MCA studies are clear and convincing evidence of the carcinogenicity of acrylonitrile in animals, and therefore, the Assistant Secretary must treat acrylonitrile as posing a potential carcinogenic risk to humans.

Although the results of the duPont epidemiological study of the Camdem, S.C. plant are "preliminary", the findings of increased incidence of cancer, particularly cancer of the lung and colon, have been determined to be highly statistically significant. As the company stated in its conclusions, ". . . persons exposed to acrylonitrile at the textile fibers plant in Camden, S.C., are at greater risk of developing cancer, as compared with company, national, and regional experience." The duPont results are, therefore, highly supportive of the finding of carcinogenicity of acrylonitrile.

There is substantial support for the view that substances shown to cause cancer in animals must be treated as posing a carcinogenic risk to humans. In addition, the best available evidence indicates that no safe level for exposure to a carcinogen, including acrylonitrile, can be established at present.

The scientific determinations underlying the regulation of carcinogens have been the basis for prior policy decisions made, after scientific debate, by OSHA and other government agencies. For example, see the preambles to OSHA's carcinogen standard, applicable to 14 selected substances, 29 CFR 1910.1003-1910.1016 (39 FR 3758) aff'd, "Synthetic Organic Chemical Manufacturers Assn. v. Brennan," 503 F. 2d 1155 (3d Cir. 1974); the vinyl chloride standard, 29 CFR 1910.1017 (39 FR 35892), aff'd, "The Society of the Plastics Industry v. OSHA", 509 F. 2d 1301 (2d Cir.), cert. den., 421 U.S. 992 (1975); the coke ovens emissions proposal (40 FR 32268 (1975)) and final, 29 CFR 1910.1029 (41 FR 46742 (1976)); and the DBCP emergency temporary standard, 29 CFR 1910.1044 (42 FR 45536 (1977)).

OSHA has outlined the agency position on regulation of carcinogens, along with a detailed discussion of the scientific evidence supporting such regulation, in the proposed rules on identification, classification, and regulation of toxic substances posing a potential occupational carcinogenic risk ("Cancer Policy"), which was published in the Federal Register on October 4 (42 FR 54148). In the proposed Cancer Policy, OSHA restates the determination that as a prudent policy matter, in the absence of a demonstrated safe level or threshold for a particular carcinogen, it must be assumed that none exists. ". . . (O)nce a qualitative presumption of carcinogenicity has been established for a substance, any exposure to the substance must be considered to be attended by risk when considering any given population. No exception to this point has yet been demonstrated." (42 FR at 54166.)

That cancer and substances which cause cancer pose a grave danger within the meaning of section 6(c)(1)(A) needs little supportive discussion. The nature of the cancer hazard differs from many other types of toxicity. Employees exposed to carcinogens risk incurable, irreversible, and usually fatal consequences. No symptomatic evidence of the development of the cancer may be apparent to the employee during a long latency period of 10-30 years or more. (In the duPont study, this fact was recognized by the investigators, whose determinations of increased cancer incidence were based upon 15 and 20 year latency periods for the cohorts involved.) In some cases, a single exposure episode may be sufficient to cause cancer. These factors, which establish the grave danger posed by exposure to carcinogens, also lead inexorably to the conclusion that it is necessary to provide immediate protection for employees through the issuance of an emergency temporary standard, within the meaning of section 6(c)(1)(B) of the Act.

The need for immediate regulation to limit exposure to acrylonitrile is apparent from the above discussion. As a carcinogen, acrylonitrile can pose its life-threatening danger in a very brief period of exposure. Without this emergency temporary standard, employees would continue to be exposed to this threat during the period of time necessary to complete the normal rulemaking process. Issuance of this ETS is, therefore, necessary to protect employees from this grave danger.

### IV. Background

#### A. Physical Properties, Manufacture and Use of Acrylonitrile

Acrylonitrile ($CH_2=CHCN$; CAS #000107131) (AN) is a widely used chemical intermediate in the manufacture of acrylic fibers, synthetic rubbers and plastics. (*6*) Its use in the manufacture of a number of acrylic fibers and copolymer resins accounts for most of the 1.5 billion pounds of AN produced annually in the United States. (*7*) AN is a clear, colorless (when pure) or yellowish liquid with a characteristic odor at relatively high concentrations and a molecular weight of 53.06. It is very reactive and polymerizes violently in the presence of strong bases. Pure AN is subject to self-polymerization with rapid pressure development (the commercial product is inhibited and not subject to this reaction). AN is a volatile (vapor pressure 83 mm Hg at 68° F), flammable liquid with a flash point of 30° F (open cup), is easily ignited and may release cyanide gases when burned, especially where the supply of oxygen is limited. Its vapors are heavier than air, and when diffused over a considerable range of concentrations in air (3 percent-17 percent by volume), are highly explosive. Synonyms for AN include acrylon, carbacryl, cyanoethylene, fumigrain, 2-propenenitrile, VCN, ventox, and vinyl cyanide. (*8*)

AN is produced almost exclusively by the ammoxidation of propylene in the presence of a catalyst. Approximately 1.5 billion pounds of AN were

produced in the United States in 1976. Current producers of AN in the U.S. are American Cyanamid, duPont, Monsanto, and Vistron (SOHIO).

The major use of AN is in the production of acrylic and modacrylic fibers by copolymerization with other monomers such as methyl acrylate, methyl methacrylate, styrene, vinyl bromide, binyl acetate, vinyl chloride, or vinylidene chloride, individually or in combination. Acrylic fibers are, by definition of the Federal Trade Commission, fibers composed of at least 85 percent (by weight) acrylonitrile units. Fibers composed of at least 35 percent but less than 85 percent acrylonitrile units are referred to as "modacrylic fibers." AN-based synthetic fibers are used in the manufacture of apparel, carpeting, blankets, draperies, and upholstery. Major producers of acrylic and modacrylic fibers include American Cyanamid Co., Dow Badische Co., E. I. duPont de Nemours & Co., Tennessee Eastman Co., and Monsanto Corp. Acrylic and modacrylic fiber production constituted 50% of the total AN consumption in the United States in 1976.

The manufacture of acrylic fibers involves four basic steps. First, the acrylonitrile must be polymerized; second, the polymer must be dissolved in a solvent to form a viscous solution which can be forced through a spinnerette (spinning head); third, the polymer must be spun into fiber; and, fourth, the fibers must be processed, crimped, cut, dried, and baled. The production of acrylic fibers is done by either wet-spinning or dry-spinning. Both methods require that the polymer be dissolved in a suitable solvent. The solvent used may vary from company to company.

The dissolved polymer is extruded through the spinnerette, or spinning head, which is a metal plate with thousands of tiny holes in it. The polymer is extruded through the holes in the spinnerette and coagulated to form the fibers. The solvent and excess, or residual AN monomer are then removed from the fibers. In dry-spinning, the solvent is removed by hot gases. In wet-spinning on the other hand, the fibers are extruded into another liquid bath, which serves to remove the solvent. For both types of spinning, the resulting fibers must be stretched to increase their strength, and then crimped to provide the desired texture and facilitate processing on textile machinery. Where the wet spinning process is used, the fibers are drawn from the coagulation bath through various warm water baths to remove any remaining solvent before they are drawn through the hot water stretching bath. It is during this stage of the wet-spinning process, between the coagulation bath and the hot water stretch, that potential employee exposure to acrylonitrile is greatest, since residual AN monomer in the fiber is being driven off along with the solvent.

At the drying stage, there is a negligible exposure to AN monomer of persons handling the acrylic fibers for further processing. This is because residual AN levels are usually well below 20 parts per million for all finished fibers and the fibers do not release their residual AN easily. In the dry, cool state the fibers are linear in structure and the polymer units are tightly coiled. At the glass transition temperature the polymer uncoils, allowing the release of anything being held in that coil (e.g., residual monomer or water). Since the fiber has a great affinity for water and water tends to extract the residual AN, removal of residual AN at the wet glass-transition temperature is fairly complete. As the fibers are normally washed at this temperature during processing, little residual AN remains in the final product. Because polymers such as acrylic fibers, which contain long sequences of AN units, tend to cyclize (i.e., form a new polymer with chains of 6-sided rings) at temperatures above 250°C instead of reverting to their component monomers, little, if any acrylonitrile exposure results from decomposition of the fibers.

Other major uses of AN include the manufacture of ABS (AN-Butadiene-Styrene) and San (Styrene-AN) resins and plastics, nitrile elastomers, and latexes (rubbers), and as an intermediate in the production of other chemicals such as adiponitrile and acrylamide.

ABS resins and plastics are produced from three monomers, acrylonitrile, butadiene, and styrene, and have a wide range of uses. They can be processed in many different ways into a variety of fabricated products. In the manufacture of ABS resins butadine and styrene are copolymerized to form a "spine", or base polymer. Styrene and acrylonitrile chains are then grafted onto this base polymer. In a separate operation, acrylonitrile and styrene are copolymerized to form a resin, and this resin is then mixed with the grafted polymer to produce a latex. The latex is then flocculated (formed into clumps), filtered, washed, and dried.

Potential exposure to acrylonitrile occurs at many points during the ABS resin manufacturing process. This operation involves the conveyance of AN monomer from storage tanks to various process areas and necessarily includes many valves, gaskets, pipes, sampling points, and other areas where AN may be released, either from leaks in the equipment or from the opening of the system, as during sampling. In addition, the blending, flocculation, and drying areas are potential areas of exposure, because the mechanical and heat processing of the polymer latex causes residual AN in the polymer to be released. Since suspension and solution polymerization processes involving latex or slurry usually result in relatively high levels of residual AN, the processing of the polymer can result in a substantial release of AN.

The manufacture of nitrile rubber from acrylonitrile and butadiene also involves the processing of latex and slurry, and therefore, includes similar areas of potential exposure to AN monomer. In addition, the polymerization process for the production of nitrile rubber results in higher employee exposures (both actual and potential), since the polymerization process is not complete when the contents of the reactor, called the "charge", are transferred to the blowdown tank. The latex, therefore, contains a considerable amount of residual monomer when it is moved from the blowdown tank to the distillation tank for "steam-stripping" (steam-stripping involves the removal of residual monomer with steam). Even after stripping, the latex contains enough AN monomer to cause high exposures in the coagulation tank area, and subsequently in the washing and drying areas.

Because of the presence of residual acrylonitrile monomer in virtually all AN-based polymers, it is necessary to discuss the potential for exposure of employees who process acrylic fibers, ABS resins, and other materials.

The low level of residual AN in acrylic fibers, once they are crimped and cut, as well as the degree to which the AN is bound up in the polymer, makes the handling of acrylic fibers an unlikely source of acrylonitrile exposure. In order to release the residual AN from the fibers, it is necessary to heat them to their glass-transition temperatures, which would discolor and spoil the product. In addition, even if such temperatures were to be reached, the low amounts of residual AN which are present in the fibers (less than 20 ppm, from data submitted to the record) would not be expected to result in a significant exposure situation.

Where the intermediate product is a polymer latex or solution, as with polymer polyols, there is a definite possibility of AN exposure of employees involved in the processing of that product into a final product. For example, where the product is processed by heat or pressure, as is done in polyurethane foam fabrication, residual AN monomer in the polymer may be driven off. If the stripping of monomer from the polymer before it is packaged for further processing is incomplete, there may be sufficient monomer left in the polymer to result

in substantial exposures of employees handling it in subsequent processing operations.

The wide use of ABS resins in plastics manufacture provides a major potential source of employee exposure to AN. ABS resins are extremely versatile polymers, and they may be processed into finished parts by almost any of the generally recognized thermoplastic conversion processes, such as injection molding, extrusion, and other basic thermoforming techniques. ABS plastics can also be mechanically formed into parts by blow-molding or cold stamping of sheet plastic for example.

Besides being used alone to make fabricated products, ABS resins can be combined with other resins, such as PVC in various ratios, to produce products with wide-ranging qualities and capabilities.

Thermoplastic processing of ABS resins involves a melting of the polymer, followed by injection into a mold, extrusion of ABS into sheet or pipe, thermoforming of extruded ABS sheet plastic into products, or comparable processes. When the polymer is melted, residual AN monomer may be released into the workplace.

It would appear that in general the higher the residual AN content of the polymer, the higher the resultant levels of AN vapor released into the workplace. However, because of the extremely wide use of ABS resins, and the wide range of uses and processing techniques employed, no precise correlation can be made between the level of residual AN in the ABS resins and AN exposures during thermoplastic processing operations.

A further difficulty connected with ABS resins and plastics involves the phenomenon of "depolymerization." Due to the nature of the polymer chains and grafts in ABS plastics, when they are heated to temperatures well in excess of their melting points, the polymers tend to revert to their component monomers. Although this phenomenon would more likely occur because of an accident or abnormal situation, such as the overheating of an extrusion head, the possibility of its occurrence in any situation involving heat-processing must be considered. (*9*)

### B. HEALTH EFFECTS OF EXPOSURE TO ACRYLONITRILE

1. *Carcinogenicity—Evidence in Animals.* In March 1977, Dow Chemical Co. laboratories prepared an interim report on a 2-year rat ingestion study of acrylonitrile, which it is conducting under the auspices of the Manufacturing Chemists Association (MCA), to assess AN's chronic toxicity and potential carcinogenicity. (*3*) In this study, AN was incorporated in the drinking water of Sprague-Dawley rats at concentrations of 0, 35, 100, and 300 ppm. The number of animals at the beginning of the study was approximately 50 animals/sex/group, plus an additional 10/sex/group intended for interim sacrifice after the first year. The interim report issued by Dow contained data on the pathological examination of the sacrificed animals. This report showed an increased incidence of tumors of the stomach, central nervous system (CNS), and Zymbal gland of the ear canal in rats receiving 100 and 300 ppm acrylonitrile. For the combined male and female rats, the incidence of the various tumors was as follows: stomach papillomas were 1 of 20 rats at 100 ppm and 12 of 20 at 300 ppm; CNS tumors were 6 of 20 rats at 100 ppm and 3 of 20 at 300 ppm; and Zymbal gland carcinomas were 2 of 20 at 100 ppm and 2 of 20 at 300 ppm. No such tumors were found in the control rats.

In a letter from MCA on April 11, 1977, it was reported that the same type of CNS tumors as seen in the groups of rats receiving doses of 100 and 300 ppm had been found in two rats at 35 ppm, the lowest test level. (*1*) The CNS tumors seen at all test levels of this study were microglioma, primarily of the brain and one of the spinal cord. This type of tumor is rare and unusual in the rat, occurring spontaneously at a rate of approximately 1% or less.

In a 2-year study being conducted by Dow involving inhalation exposure of rats to acrylonitrile, male and female rats are being exposed to 0, 20, and 80 ppm acrylonitrile for 6 hours per day, 5 days per week (*1*) After the first year of the study, 13 rats per sex, per dose were sacrificed, and the following results were reported: 3 rats in the 80 ppm group had tumors of the CNS which were reported to be "comparable" to those reported in the 2-year ingestion study; increased incidences of ear canal tumors and mammary region masses were detected at the 80 ppm level; an apparent increase in the subcutaneous masses of the mammary region was detected in the rats in the 20 ppm group; and no ear canal or CNS tumors were seen in the rats in the 20 ppm group. The finding of similar tumors in the inhalation and ingestion studies gives evidence of the apparently systemic nature of the carcinogenic effect of acrylonitrile after absorption.

With the exception of the mammary gland tumors and ear canal tumors, all types of neoplasms discovered in the treated animals are relatively rare in 18–24 month-old rats, occurring spontaneously at an incidence of approximately 1%.

In his evaluation of the data from the MCA-sponsored animal studies on acrylonitrile, Dr. Robert Squire, a recognized pathologist/oncologist and Associate Professor at the Johns Hopkins University School of Medicine, made the following observations:

> Interim or preliminary data is not customarily considered appropriate for carcinogenic evaluation, since the more common tumors which occur with variable incidence in test animals may produce false positive trends which are not supported by final observations.
>
> However, particularly in the case of brain and stomach tumors of this type, immediate concern is warranted by the interim observations. These are rare tumors which do not occur in any rat strain at any age at incidences comparable to those observed in this experiments. Experience in laboratory animal oncology, plus the recent observations of additional tumors in remaining treated animals indicates that the evidence for carcinogenic effect will undoubtedly become more conclusive as the experiments progress.
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> The conclusions can clearly be drawn that acrylonitrile is carcinogenic under the conditions of this experiment. There is definite indication that malignant neoplasms of the central nervous system were induced at all dose levels by the oral route and at the 80 ppm level in the inhalation study. Benign gastric neoplasms, and preneoplastic epithelial alterations in the stomach are also clearly treatment related.
>
> Although the malignant ear neoplasms and the mammary neoplasms occurred with low incidence in the initial report of interim observation, their numbers still exceeded that in the controls, and that expected according to historic observations. A tentative conclusion must be that these are also treatment related. (*10*)

In addition, three other Board Certified Pathologists, Drs. David Groth, Choudari Kommineni, and Ralph Yodaiken, all currently employed by NIOSH, examined the rat-tissue sections prepared by Dow and reviewed the results of the MCA studies. Their reports were transmitted to OSHA in a NIOSH memorandum dated December 7, 1977. In his report, Dr. Yodaiken stated that

> (d)espite the small number of animals (10 per group) examined thus far, the results are both statistically and biologically significant. Acrylonitrile appears to be responsible for malignant change occurring in the central nervous system; the ceruminous glands of the ear canal, far in excess of any spontaneous tumor incidence; and possibly for the early appearance of mammary gland tumors. The papillomata of the stomach must be considered both directly related to the ingestion of the acrylonitrile and premalignant. In their report, Drs. Groth and Kommineni note that "(i)t is interesting that there is a dose response relationship with the stomach papillomas but not with the brain tumors (incidence being about the same in both high dose groups)" and conclude that "* * * acrylonitrile is a carcinogen in rats." (*13*)

*Evidence in humans.* In May 1977, E. I. duPont de Nemours and Co., Inc. (duPont) made available to OSHA the preliminary results of an epidemiologic study of duPont workers at the company's textile fibers plant in Camden, South Carolina (*5*). The

study indicated excess cancer incidence and cancer mortality as compared with company and national experience. The study included 470 male employees who began working in the polymerization area of the plant between 1950 and 1955 and who were either still actively employed by, or had retired from the company.

The study analyzed data through 1975, allowing for a 20-year latency period for the cohort studied. The company observed an incidence of 16 cancer cases among active employees, as compared with an expected number of 5.8 (based on company rates) or 6.9 (based on national rates). Of the 16, there were six lung cancers (1.5 expected), three colon cancers (0.5 expected), and one cancer in each of seven other primary sites as compared with fractional expected values. The differences between observed and expected cases were statistically significant.

DuPont reported that all cancers found occurred among those employees who were first exposed to AN between 1950 and 1952. This is not surprising in light of the latency period for various forms of cancer which can range up to 20 years or longer. Although there is little or no data available on employee exposures to AN during this period, there is also no safe level currently known for exposure to carcinogens. While it is conceivable that the exposures in question were well above those later achieved in these operations, the duPont study does not indicate the levels to which these employees were exposed, and no direct correlation has been demonstrated between any specific level of exposure and the increased incidence of cancer in this cohort. Even if such direct correlation could be made, this would not establish the level which actually induced the cancers observed. Some of the individual cancers in question may have actually been initiated at exposures well below that particular level. The complexity of carcinogenesis, including the factors of the long latency periods involved and the multitude of conditions relating to individual sensitivities to carcinogens make it difficult at this point in time, to demonstrate that exposure to any specified quantity of AN is, in fact, safe.

DuPont also reported that mortality data for the same cohort showed eight cancer deaths, as opposed to 4.0 (company rates) or 5.1 (national rates for white males in 1970) expected. These differences were also statistically significant. Of the eight cancer deaths, four were from lung cancer (1.5 expected), while the other four were cancers of different primary sites.

DuPont is presently attempting to trace an additional 484 employees who were first exposed to acrylonitrile in the Camden plant between 1950 and 1955, but who had either been laid off or quit employment with the company.

In a letter accompanying the preliminary results of the study, the corporate medical director for duPont stated that while the company does not consider the study to provide definitive evidence that acrylonitrile is carcinogenic in man, "these findings, when considered together with the results of the animal tests which were reported previously, raise a serious suspicion that it may be a human carcinogen." (*5*) While these data show a higher frequency of lung and intestinal cancer, these tumor types alone are not entirely responsible for the significant excess of cancer seen in the cohort. Although the variety of primary tumor sites observed is an unusual manifestation of carcinogenic response, this finding is corroborated by a similar pattern shown in the animal ingestion and inhalation studies described above.

In their analysis of the duPont report, NIOSH has stated:

> (i)t is interesting to note that, in addition to these two specific sites, cancer of eight additional sites (prostate, lymphosarcoma, Hodgkins, (penis), thyroid, nasopharynx, bladder, and pancreas) occurred among the workers in this cohort. As pointed out by the investigator, this nonspecificity of tumor site is reflected in animal studies in which acrylonitrile was ingested or inhaled.
>
> Interpretation of these results is severely limited by two major factors:
>
> (1) The vital status of a large proportion (36%) of the cohort has not yet been determined, and
>
> (2) complete work histories have not been obtained to provide information on exposure to substances other than acrylonitrile.

However, the excess of lung cancer and cancer of the large intestine in both the morbidity and mortality analysis is clearly suggestive of a cancer problem among acrylonitrile workers." (*13*)

The influence, if any, of cigarette smoking is relevant when assessing the factors which may contribute directly or indirectly to any excess of lung cancer in humans. The authors noted that the preliminary report did not include the smoking histories of the cohort, but the final analysis is expected to do so.

Finally, duPont's epidemiologist concludes in her report that:

> Based on these preliminary findings, it can be concluded that persons exposed to AN at the textile fibers plant in Camden, South Carolina, are at greater risk of developing cancer, as compared with company, national and regional experience. (*5*)

2. *Mutagenicity.* The detection of carcinogens as mutagens has been shown to be 85–90 percent accurate in the *Salmonella typhurium* assay described by Joyce McCann, et al. (*14, 15*) It has been shown to have similar accuracy in identifying noncarcinogenic chemicals, although some carcinogenic mutagens, such as dimethylnitrosamine, first require metabolic conversion to their active form. As yet unpublished research has shown that an assay procedure with *S. cerevisae* is about 60 percent accurate in the detection of those carcinogens which increase the rate of mitotic recombination. (*16*) Although the test systems are not 100 percent accurate and neither a positive nor a negative response absolutely proves a chemical to be hazardous or nonhazardous to humans, the use of both assay procedures significantly enhances the probability of detecting potentially hazardous chemicals.

Several researchers employing a variety of methods, have investigated the mutagenic potential of acrylonitrile. AN has been shown to be weakly positive in two separate bacterial mutagenesis tests using the Ames *Salmonella* system. (*17*) In the presence of a mouse liver homogenate, AN produced mutations in the TA 1535, TA 1538 and TA 1978 strains of *Salmonella typhurium* at low atmospheric concentrations (exposures to 57 ppm resulted in mutagenic effects). The use of an exposure chamber facilitated the control of the exposure atmosphere and minimized inaccuracies stemming, in part, from the high volatility of AN.

Another study indicated that AN is weakly mutagenic to TA 1535 metabolically activated with rat liver homogenate. (*18*) Venitt, Bushell and Osborne found the mutagenic effects of AN on the WP2 series of *E. coli*, to be weak and "reliably demonstrable only within a narrow range of doses when measured by the plate tests." (*19*) These results were nevertheless statistically significant and highly reproducible. The authors repeated these experiments using the simplified fluctuation test described by Green, et al., which confirmed the results of the plate tests. (*20, 21*) This procedure also enabled the authors to reliably detect mutagenic activity at levels of AN which were 20 to 40 times lower than those used in the plate tests, thereby minimizing the effects of AN toxicity seen at the higher levels. These same authors were unable to reproduce the positive results reported by either the duPont Co. (*18*) or Milvy (*17*) when proceeding without the use of an exposure chamber. More confirmatory evidence of the mutagenicity of AN was provided by McCann, et al. in experiments incorporating the resistance transfer factor pKM 101 plasmid which increases microbial sensitivity to the mutagenic effects of chemicals. (*22*) As expected, AN was more mutagenic in this system. A limited positive mutagenic response was demonstrated by Brusick and Mayer in a study using the D4 strain of *Saccharomyces* in a

non-activated system, although the authors did not regard these results as signficant. (*23*)

Two studies done on six different strains of Salmonella which used neither the fluctuation test nor the exposure chamber methods showed no activity at all. (*16, 24*)

The wide variation of test results reported in the area of mutagenicity would appear to be closely related to the differences in the laboratory methods used and to the high volatility and toxicity of AN. The tests which gave negative results were done under experimental conditions which made no adjustments for these factors. Without repetition, using appropriately controlled conditions, these experiments could not be said to show that AN is non-mutagenic.

3. *Teratogenicity.* The effects of maternally ingested acrylonitrile on embryonal and fetal development have recently been studied in an attempt to further define the extent to which AN can affect biological systems.

In an evaluation of the teratologic effects of AN, Murray, et al. reported incidences of several significant fetal malformations as well as evidence of embryotoxicity. (*4*) Doses of 0, 10, 25 and 65 mg of AN/kg/day were given to pregnant Sprague-Dawley rats by gavage on days 6-15 of gestation. The highest dose-level was significantly maternally toxic and produced increases in a variety of malformations among the fetuses in addition to evidence of embryotoxicity. The next lowest dose, 25 mg AN/kg/day, produced less maternal toxicity and a low incidence of the same signs of embryotoxicity and fetal malformations. No evidence of maternal toxicity or effects on the developing embryos or fetuses was apparent at the lowest dose of AN administered (10 mg AN/kg/day). The possibility that maternal toxicity was the sole cause of the malformations seen in this study is discounted by the authors for two major reasons. First, their experience in other studies of this type indicates that the kinds of malformations seen here had historically not increased in incidence in fetuses of pregnant rats subjected to similar or even greater stress. Secondly, the degree of toxicity observed in the dams apparently did not correlate with the occurrence of malformations seen in their respective offspring.

In reproduction studies of a series of nitriles (acrylonitrile, adiponitrile and B,B'-oxydipropionitrile) conducted by Svirbely and Floyd, groups of Holtzman strain Sprague-Dawley rats were given 10, 100 and 500 ppm of the individual nitriles in their drinking water. (*25*) Data from two first-generation litters showed decreases in the indices of fertility, gestation and viability in the group given the highest doses of AN. Growth retardation was also seen in the offspring of this high-dose group and in addition, a progressive muscular weakness in the hind limbs of the females at the 500 ppm dose developed unexpectedly 16-19 weeks after the weaning of the second litter (while this study was to be continued through three generations, the data for the succeeding two generations was not made available).

In summary, it should be noted that in their final decision on Acrylonitrile Copolymers Used to Fabricate Beverage Containers, the Food and Drug Administration (FDA) stated that "the available toxicology data demonstrate that acrylonitrile is a teratogen, a mutagen, a tumorigen, and probably a carcinogen" (42 FR 48528 at 48542).

4. *Other toxic effects.* Acrylonitrile (AN) has long been recognized as a highly toxic substance, and its toxicity to humans and other mammals by inhalation, ingestion, skin contact and injection has been shown both clinically and experimentally.

Until recently the toxicity of AN was thought to be primarily due to the inhibition of cellular respiration by the in vivo release of cyanide ions (similar in its action to inorganic cyanide), and producing no permanent physiological damage. (*26, 27, 28*) There is now considerable evidence indicating that while the in vivo decompostion of AN may release some cyanide within the body, the primary toxic effect of this substance is a result of its own chemical composition. (*29, 30, 31, 32*)

Human symptoms of exposure to AN have been those associated with the CNS, gastrointestinal, respiratory, and peripheral blood systems. They have included headache, dizziness, abdominal pain and vomiting, fatigue, asthenia (weakness), diarrhea and jaundice as well as some instances of convulsions, chronic effects on enzyme systems and other biochemical disorders. Apart from the above effects which can result from exposures due to absorption through the skin, prolonged or repeated skin contact has been found to cause dermatitis due to the solvent effect of AN on the skin. Irritation and blistering has been reported in instances where AN has been held against the skin, with effects resembling a second degree thermal burn but with little or no accompanying pain.

In addition, acute intoxication resulting in death has been reported in children. Several children died while sleeping in rooms which had been disinfected with AN. (*36*) Another died four hours after AN was applied to the scalp as a delousing medium. (*37*)

Several cases of AN poisoning in workers were reported by R. H. Wilson in 1944. (*35*) The most frequent symptoms included slight jaundice, gastritis, respiratory oppression and fatigue. In a later study, Wilson reported that workers exposed to 16-100 ppm for 20-45 minutes experienced respiratory and nervous system effects. (*34*)

In an epidemiologic study of health impairment among acrylonitrile workers in Japan, Sakurai and Kusumoto studied 576 workers exposed to AN in concentrations of less than or equal to 5 ppm and less than or equal to 20 ppm over a 10-year period from 1960 to 1970. (*38*) The cohort was studied with respect to both age and length of exposure to AN, and subjective complaints as well as objective symptoms were examined. The authors found that increased incidences of subjective complaints including headache, fatigue, nausea and weakness, as well as of abnormal values of some of the objective tests, such as anemia, jaundice, conjunctivitis, specific gravity of whole blood, blood serum and cholinesterase values, urobilinogen, bilirubin, urine protein and sugar. These were found to vary directly with length of exposure to AN and were statistically significant. The authors concluded that AN exposures at these levels caused mild liver injury and a probable cumulative toxic effect.

Orushev and Popovski examined the results of a clinical study conducted on twenty workers exposed to AN vapors and others chemicals in an acrylic fibers plant. (*39*) The AN concentrations in the workroom air ranged from 3.0 to 20 mg/m³ (1.38 to 9 ppm), with an average value of 7.5 mg/m³ (3.4 ppm) of AN in air. Most of the symptoms observed were CNS-related.

The clinical symptomatology reported here is similar to that described by Shustov in workers employed in the production of AN. Shustov speculates that blood disorders detected may be the result of a disturbance of enzyme activity. (*40*)

In a later study of 390 Russia nitrone workers exposed to AN, methyl acrylate and sodium thiocyanate in the synthetic fiber industry, Shustov and Mavrina reported a number of systemic disorders, including changes in the cardiovascular and hematopoietic systems, the gastrointestinal tract and liver. (*41*) (Nitrone is a synthetic fiber made by polymerization of AN or by copolymerization of AN with methy acrylate in a sodium thiocyanate solvent). Measurements of AN in the work-room air ranged from 0.8 to 1.8 mg/m³ (0.37 to 0.83 ppm) with some areas reaching 3.75 mg/m³ (1.73 ppm). Subjective complaints among 340 nitrone production workers included headache, dizziness, insomnia, rapid fatigue, emotionality, itching of the skin and burning of the throat. Fifty workers with 3 to 10 years of service in other areas of this plant (e.g., equipment operators, laboratory workers, technicians and spinners) showed evidence of functional disorders of the

central nervous system. The systems most seriously affected were reported to have been the nervous system, the cardiovascular system and the hematopoietic system in addition to significant changes in enzyme systems and the gastrointestinal tract.

In a similar study conducted in two stages between 1965 and 1971, Zotova found exposures in the work-room air ranging from 2.5 to 5 mg/m³ (1.2 to 2.3 ppm) during the first period of the study and averaging 0.75 mg/m³ (0.35 ppm) during the second period. (*42*) The author also reports finding small quantities of residual AN on equipment, handrails, ladders, doors, door knobs, windows and floors as well as accumulations of AN on workers' bodies, shoes, boots and gas masks. Workers exposed to these concentrations were found to have exhibited malaise, headache, insomnia, irritability, chest pain and poor appetite as well as tendencies towards anemia, leukopenia, inhibition of enzymes and disorders of the oxidation-reduction processes as compared to a control group.

Mavrina and Il'ina tested the immunologic reactivity of forty-five 18- and 19-year-old trade school students exposed to AN, Methyl Acrylate and Sodium Thiocyanate before, during and after 3 months of exposure to workroom air concentrations of AN reportedly ranging from 0.8 to 1.8 mg/m³ (0.37–0.83 ppm). (*43*) Statistically significant increases in immunologic reactivity were noted, along with development of functional disorders of the nervous system. Changes were also observed in the peripheral blood picture with decreases in numbers of erythrocytes, hemoglobin levels and leukocytes and increases in the number of eosinophilis in a fourth of the subjects.

Since the reports of the above-mentioned studies do not, for the most part, include the data collected or much description of the experimental methods or analytical techniques used, critical evaluation of these studies is not possible. Their value is enhanced, however, by the similarities of the findings reported by the various researchers and the correlation of the systems effected with those implicated in the animal studies. Of particular interest is the frequency of CNS-related symptoms in view of the data reported on CNS tumors in both the animal and human studies. The potentially serious nature of possible chronic toxic effects of AN (even at the low levels reported by these authors) must be given due consideration.

The present 20 ppm standard for AN was originally based on a comparison of the toxicities of AN and hydrocyanic acid (HCN) in humans and animals and the assumption that AN is almost completely hydrolyzed to HCN. In 1942, Dudley and Neal concluded that the toxicity of AN is attributable to a molecular cleavage with production of HCN and separation of the CN group which actively interferes with tissue respiration. (*27*) Ten years later Brieger, Rieder and Hodes (1952) exposed rats to several concentrations of AN vapors and found small quantities of HCN in the blood of those exposed to 100 ppm of AN vapors while none was detected in rats exposed to lower concentrations. (*26*) These authors concluded that AN is metabolized to cyanide in vivo while others (Benes and Cerna, 1959; (*29*) Paulet and Desnos, 1961; (*30*) Paulet, Desnos and Battig, 1966; (*31*) and Hashimoto and Kanai, 1965 (*32*) have since concluded that the toxicity of AN is due to the whole molecule rather than to liberated HCN. The mode of action of AN toxicity remains a debatable issue and is still under investigation.

In 1947, Tullar reported fatalities in the males of different animal species resulting from oral, intraperitoneal or intravenous administration of AN in doses ranging from 36 to 85 mg/kg given at different rates over various periods of time. (*44*) The author found AN to be relatively toxic and to be very slowly eliminated from the body. Although this two-year feeding study was not specifically designed to investigate the potential carcinogenicity of AN, four of the test rats developed tumor-like growths while none of these were found in the control animals. In addition, no similar growths were found in any of the approximately 400 other rats from the same stock, nor were such tumors found in the breeding stock from which these animals were taken.

Other reported toxic effects of AN in animals include damage to the central nervous system, lungs, liver, kidneys, cardiovascular system and blood elements. In 1971 and 1972, Knobloch, et al. observed acute lesions and edema of the central nervous system (CNS) and evidence of neuronal damage following acute subcutaneous, intraperitoneal or inhalation administration of lethal and sublethal doses of AN in rats. (*45, 46*) Histological damage to neurons was noted after three weeks of daily intraperitoneal injection of 50 mg/kg and neuronal edema and chromatolysis after 6 months of inhalation of 250 mg/m³ (115 ppm) AN in air. Biochemical changes in the CNS have also been described in response to acute lethal and sublethal doses of AN. (*32*)

In 1952, Brieger, et al. noted "breathing difficulties" in dogs inhaling AN vapors at a concentration of 217 mg/l³ (99.8 ppm) AN in air for a few hours. (*26*) Dudley and Neal observed weak respiratory effects in rabbits and cats exposed to the same concentration, (*27*) while Dudley, Sweeney and Miller found subacute bronchopneumonia, alveolar edema and extravasation of serum and erythrocytes into the alveoli as well as focal centers of lymphocytes and polymorphonuclear leukocytes in guinea pigs, rabbits, rats and cats exposed over a period of 8 weeks to an average concentration of 0.22 mg/1 (99 ppm) AN in air. (*28*) Experiments done by Knobloch in 1971 produced strong irritation of the lungs with production of lesions hyperemia (excess blood), edema (swelling due to an accumulation of excessive fluid) and diapedeses (bleeding through intact blood vessels) in rats having single exposures to 680 ppm (1.5 mg/1) of AN for four hours. (*45*) Chronic studies done by Knobloch, et al., in 1972 showed a purulent exudate in the lungs of rats inhaling concentrations of 250 mg/m³ (115 ppm) of AN in air 5 times a week for 6 months. (*46*)

Pulmonary effects have also been produced in animals exposed to AN by other routes of administration. Benes and Cerna exposed rats and mice to AN perorally, subcutaneously and intraperitoneally and found pulmonary edema in approximately 50 percent of the animals. (*29*) Knobloch, et al. (1971), found histological changes in the lungs of rats given sublethal doses of AN subcutaneously and intraperitoneally. (*45*)

The effects of AN on the blood have also been shown by Knobloch, et al. (1971). (*45*) Ten rats given intraperitoneal doses of AN increasing every four days from 10 to 114 mg/kg over a twenty-day period and eight rats given 50 mg/kg intraperitoneally each day displayed a reduced rate of growth, leukocytosis, an increase in the proportion of neutrophilic leukocytes and a decrease in the proportion of lymphocytes in the blood.

Several authors have also considered possible cumulative toxic effects of AN exposure. Knobloch et al. (1971), describe symptoms such as decreased weight gain, inhibition of normal increase of hemoglobin levels and erythrocyte counts for young rats, leukocytosis and neutrophilia in the peripheral blood, pulmonary inflammation, kidney damage, localized fatty degeneration of the liver and pathological changes in mucosa as well as enlargement of the heart as indications of cumulative effects over a three week series of daily intraperitoneal doses of 50 mg/kg. (*45*) The authors noted a pronounced difference between the toxic effects of AN and those of inorganic cyanides. The slow development of symptoms of AN intoxication was interpreted as an indication of the possibility of a cumulative toxic effect of AN with repeated doses. In 1960, Komissarov demonstrated the accumulation of a toxic effect on the receptors of the central nerves of the small intestine. (*47*)

It is interesting to note that the systems affected in studies of acute lethal and sublethal doses of AN in both animals and humans are the same as those which are affected in long-term studies where toxic effects are manifested by the development of tumors in these systems.

SUMMARY AND EXPLANATION OF THE STANDARD

The requirements of the emergency temporary standard are those which OSHA considers essential and feasible to protect employees from the grave danger resulting from acrylonitrile exposure until a permanent standard can be promulgated in accordance with sections 6 (b) and (c) of the Act. The following section discusses the significant provisions of the emergency temporary standard for acrylonitrile and the necessity for including these provisions in the ETS.

1. *Paragraph (a).*—Scope and application. This standard applies to all occupational exposures to acrylonitrile except for the processing, use and handling of certain polyacrylonitrile products, as discussed below.

The principal activities covered by this ETS include the manufacture of acrylonitrile, the production of acrylic and modacrylic fibers, the manufacture of ABS (acrylonitrile-butadiene-styrene) and SAN (styrene-acrylonitrile) plastics and resins, and the manufacture of nitrile rubber, as well as numerous specialty polymers, plastic and polyurethane intermediates, and polymer solutions. The ETS also covers related activities, such as packaging, repackaging, storage, transportation, and disposal of acrylonitrile.

For the purposes of the ETS, the term "polyacrylonitrile", or "PAN", refers to any polymer produced from acrylonitrile alone or in combination with other monomers and additives except for materials which are exempted from the ETS, as discussed below.

Although the scope of the ETS is broad, it does not apply to all operations in which AN is merely present. Rather, it is OSHA's intent to cover in the ETS, those operations with the highest exposures, while reserving judgment for the final rule as to whether or not additional operations should be covered.

OSHA has determined that the highest potential for exposures to AN exists in operations from manufacture of AN through the polymerization process. The provisions of the ETS apply to these types of operations. Moreover, OSHA recognizes that there may be significant quantities of residual AN present in the various types of resins, plastics, and rubbers which are manufactured from the monomer. The processing of many of these products can result in significant exposures to employees through the release of the residual AN from the product. Therefore such operations are included in the ETS. However, on the basis of information presently available, fabricating and processing operations involving products made from PAN are not subject to the provisions of the ETS where the likelihood of release of significant quantities of AN is remote. The specific conditions for such an exemption are spelled out below. It is anticipated that this exemption will focus employer attention on the most serious problems first, while relieving many downstream employers from the requirements of the ETS.

Operations involving fabricated products made in whole or in part from polyacrylonitrile are exempted from the provisions of the ETS, provided they meet at least one of the conditions set forth in the exemption. Under the first condition, a processor of products fabricated from PAN will be exempted from the ETS if the employer can demonstrate, with objective data, that the product is not capable of releasing AN monomer resulting in airborne concentrations in excess of 1 ppm, under expected conditions of processing, use and handling which will cause the greatest release of AN. This determination need not be based on data generated by the processor but may, for example, be based upon information provided by the manufacturer and reasonably relied upon by the processor. This provision enables fabricators of products such as ABS plastics to avoid the burdens of compliance with the ETS, while providing incentives for the manufacturers of resins and other materials to improve their monomer-stripping techniques and minimize the amounts of residual AN in their products.

Since the range of products made from AN is so wide and varied, OSHA cannot, as a general matter, specify an "acceptable" level of residual AN for all products. There is considerable variability as to the ease with which residual AN is released from different products. OSHA believes that the most effective way of reducing the potential for release of AN in workplaces downstream from the manufacturing operation is for the manufacturer of the material to be processed to reduce the residual AN content of that material.

The second possible condition for the exemption provides that if AN-based plastics or other compounds other than latex and liquid mixtures, will not be heated or melted by the fabricator in the course of processing, that fabricator will not be subject to the provisions of the ETS. This provision recognizes that some AN-based products are not processed in such a way as to result in the release of AN into the workplace in amounts above 1 ppm, regardless of the actual residual content. Operations such as cold stamping of sheet plastic, for example, would be included in this exemption.

In addition to the release of residual AN from polymer, another potential route of AN exposure resulting from the heat processing of AN polymers is thermal decomposition. At temperatures of approximately 250° C and above, ABS resins and plastics, for example, will actually "depolymerize" into their respective component monomers, AN, butadiene, and styrene. This phenomenon is one more cause for concern when AN polymers are melted or otherwise heat-treated. It should be noted, however, that acrylic and modacrylic fibers are not subject to depolymerization and do not present the same hazard of exposure to AN from thermal decomposition, since their structure precludes their depolymerization, under similar conditions of temperature and pressure.

Because of the ease with which AN is released from latex solutions, emulsions, and other liquid mixtures, these products may not be exempted from the standard under the second condition in paragraph (a)(2), regardless of the means of processing or residual AN content. It should be noted that these materials may still be exempt under paragraph (a)(1) if it can be demonstrated that they do not have the potential under expected conditions of processing, use, and handling for the release of air concentration of AN exceeding 1 ppm. There is, therefore, a recognition of the possibility that some latex or liquid mixtures are atypical in their propensity to release AN into the workplace.

Employers whose operations qualify for exemption from the ETS under one of the conditions specified in paragraph (a) are required to maintain records of the objective data upon which they are relying for exemption, and to provide such evidence as required to justify that exemption.

It should be noted that where objective data is not available to satisfy one of the conditions for exemption, the employer is required to perform, at the very least, initial monitoring of employee exposures to AN. If the results of initial monitoring indicate employee exposures are below the action level, the employer may discontinue monitoring for those employees and is relieved of other obligations under the ETS. Thus, even if operations are not specifically exempted from the ETS, exposure levels below 1 ppm will relieve many employers from further duties under the standard, except with respect to training and labelling.

2. *Paragraph (b).—Definitions.* Because of the many and varied uses, processes, and products which involve acrylonitrile, it is necessary to define several terms as they are used in the standard.

The term "acrylonitrile" refers to the AN monomer, as a liquid or gas, wherever it may be found in the manufacturing or processing of polymers, as well as in the manufacture of the AN itself.

"Polyacrylonitrile" or "PAN", for the purposes of the standard, refers to all polymers having acrylonitrile as either a raw material or a component of the polymer chain, regardless of the percentage, except for materials exempted from the standard under paragraph (a)(2). Since the number of AN units in a polymer may vary widely from product to product, and oftentimes within the same product, OSHA believes that a broad definition is necessary to assure coverage of all potentially exposed employees.

An "action level" of 1 ppm (8-hour time-weighted average), or one-half the permissible exposure limit, is provided in the ETS. The purpose of the action level is to help to relieve the burden on employers by providing a cut-off point for required compliance activities under the standard. The broad scope of the ETS necessarily encompasses many employers whose employees are exposed to levels of AN below the permissible exposure limits. Such employers are required to perform initial monitoring to determine the extent of their employees' exposures to AN. If, on the basis of the results of the initial monitoring, an employer can demonstrate that an employee is exposed to AN below the action level, the employer may then discontinue monitoring and other compliance activities for that employee. The action level concept thus provides an objective means for an employer to determine what further actions are required for compliance with the ETS.

The statistical basis for determining the action level has been discussed in connection with several proposed OSHA health standards (see, for example, Proposed Standard for Trichloroethylene, October 20, 1975, 40 FR 49032). In brief, although all measurements on a given day may fall below the permissible exposure limit, some possibility exists that on unmeasured days the employee's actual exposure may exceed the permissible limit. Where exposure measurements are above one-half of the permissible exposure limit, i.e., the action level, the employer cannot reasonably be confident that his employees may not be overexposed. (Leidel, N. A. et al., "Exposure Measurement Action Level and Occupational Environmental Variability," DHEW, PHS, DCD, NIOSH, DLCK (August 1975)). Therefore, requiring periodic employee exposure measurements to begin at the action level provides the employer with a reasonable degree of confidence in the results of his measurement program.

3. *Paragraph (c)—Permissible exposure limits.* The ETS establishes a permissible airborne exposure limit and a prohibition on eye or skin contact with AN. The eight-hour time-weighted average is set at 2 parts acrylonitrile per million parts of air (2 ppm). A ceiling permissible exposure limit is established at 10 ppm as averaged over any 15-minute period during the workday.

The clear evidence from the animal testing performed for MCA, as well as the serious implications raised by the duPont data, indicate that for the protection of the worker, we must regard acrylonitrile as posing a carcinogenic risk to exposed employees.

OSHA policy, which is based on the best available scientific evidence and which is consistent with the policies and recommendations of nearly all public bodies which have addressed the problem of exposure to cancer-causing substances, has been and is that a substance which causes cancer in animals must be regulated as a human carcinogen, and in the absence of a demonstrated "safe" or "no effect" level for human exposure to a carcinogen, it must be assumed, as a prudent policy matter, that no safe level exists.

Acrylonitrile has long been recognized as a highly toxic material. In the past, industry has endeavored to maintain employee time-weighted averages well below the existing OSHA standard of 20 ppm, based upon its acute toxicity. Whereas the results of the MCA studies, in and of themselves, establish the need to regulate acrylonitrile as posing a carcinogenic risk, the duPont report further substantiates the absence of a demonstrated "safe" or "no effect" level for human exposure to acrylonitrile. As duPont noted in their discussion of their study, and as others have indicated in comments to the record, there is no definitive data available as to the levels of exposure to AN in the Camden plant during the period covered by the study. Many people have assumed that the levels during the start-up period of the plant (i.e., 1950–1952) were much higher than those achieved during later years of operation. Consequently, it is argued that the increased incidence of cancer demonstrated by those employees first exposed to AN during that start-up period must be attributed to those higher levels of exposure to AN. No data is presently available to indicate that any given level of exposure to AN would, in fact, be free of carcinogenic risk to exposed individuals. However, even if specific levels of exposure could be demonstrated to be associated with the incidence of cancer, this could not, in and of itself, establish a safe level for exposure to AN. While specific thresholds to various carcinogens may theoretically exist for some individuals, such thresholds may vary substantially within any given population at risk as well as with time. Furthermore, the long latency periods involved in carcinogenesis make it difficult to demonstrate that exposure to any specified quantity of a chemical carcinogen was the cause of a specific carcinogenic episode many years later (5–40 years may be required before exposure to a carcinogen might produce detectable cancers.) The Assistant Secretary cannot, therefore, set an exposure level for acrylonitrile based on any "safe" level which will eliminate the cancer hazard.

OSHA recognizes that the setting of an exposure level for acrylonitrile must, therefore, be based on a determination of a level which will immediately minimize the hazard to the greatest extent possible, within the confines of feasibility. Consequently, it is determined that a prudent assessment of all pertinent factors (i.e., the health effects, the technology available for the accurate measurement and analysis of employee exposures, and the means available for reducing employee exposures) directs the establishment of an eight-hour time weighted average permissible exposure limit to 2 ppm.

OSHA believes this level is attainable through the use of engineering and work-practice controls and respirators. In fact, several employers have already set internal goals for their employees' AN exposures of 2 ppm for an 8-hour TWA, while some are already achieving it for some operations through engineering and work practice controls alone.

In addition to limiting the 8-hour time-weighted average exposures to 2 ppm, the ETS requires that no employee be exposed to acrylonitrile in excess of 10 ppm averaged over any 15-minute period. An 8-hour TWA of 2 ppm contemplates exposures to varying concentrations of acrylonitrile during the course of the workday, with some periods of exposure above 2 ppm and corresponding periods below 2 ppm. OSHA recognizes that in many operations, relatively high excursions may necessarily be encountered by employees for short periods of time. OSHA believes that the uncertainty regarding the concentrations and duration of exposure that may increase carcinogenic risk requires that the magnitude of brief excursions be limited. On the basis of submissions to the record, and in light of the flexibility permitted by the ETS as to methods of compliance, it appears that a 15-minute ceiling of 10 ppm can feasibly be achieved. Consequently, a ceiling limit of 10 ppm averaged over any 15-minute period is established.

It has been OSHA's policy, in dealing with carcinogens to limit employee exposures to such substances to the lowest levels feasible. In keeping with

this policy, OSHA is prepared to establish a permissible exposure limit for AN in the permanent standard based on data which becomes available in the rulemaking which follows.

4. *Paragraph (d)—Notification of use.* The ETS requires employers to notify the OSHA Area Director of the location of all workplaces where acrylonitrile is present, and to describe the conditions of use and exposure and the protective measures in effect. This will permit OSHA to assemble a better profile of the industry, its capabilities, and the affected workforce, and to more effectively schedule and conduct its enforcement activities.

5. *Paragraph (e)—Exposure monitoring.* The exposure monitoring provisions require the employer to determine the exposure for each employee exposed to acrylonitrile. This does not require separate measurements for each employee. If a number of employees perform essentially the same job under the same conditions, it may be sufficient to monitor a significant fraction of such employees to thereby obtain data that are representative of the remaining employees.

Because of the nature of the hazard of exposure to AN, it is necessary that the scope of the ETS be as broad as possible to protect potentially exposed employees. However, many employers will be required only to perform initial monitoring to determine employee exposures. If the results of initial monitoring demonstrate that an employee's exposure to AN is below the action level (1 ppm), the employer may discontinue monitoring and other activities under the ETS for that employee. OSHA anticipates that this provision will greatly reduce the burden on employers, while providing them with an objective means of determining whether they must take additional steps for compliance with the ETS.

Where exposure measurements are determined to be above the permissible exposure limit, the employer must monitor monthly. Where exposure measurements are above the action level but below the PEL, monitoring need only be repeated 3 months later. "Exposure" in this connection means the airborne concentration in the employee's breathing zone, with no adjustment for the protection provided by any respirator the employee may be wearing.

The employer is also required to perform monitoring again for a particular job position if any changes in production, processes, control measures, or personnel may result in new or additional exposures to AN.

A primary concern connected with any health standard, particularly when dealing with a carcinogen, is the availability of methods of monitoring and analysis of employee exposures. It is clear from data submitted into the record that there are several off-the-shelf methods of monitoring for AN which can be implemented by employers, and that many employers are already carrying out periodic monitoring activities. Among methods which have been noted in comments submitted to the record are the use of charcoal tubes, "Poropak" polymer sampling tubes, and personal badge-type dosimeters, as well as Saran bag "grab samples," detector tubes, and fixed point monitoring systems. The ETS does not require the use of one specific monitoring method, but it does specify that whatever method is chosen must meet the criteria for sensitivity and accuracy set forth in the standard.

The ETS requires the employer to notify each employee in writing of his/her exposure within five (5) days of obtaining the results of measurement. This requirement involves a written communication to each employee so that the employee will definitely be advised of his/her exposures.

6. *Paragraph (g)—Methods of Compliance.* The ETS is flexible and permits a variety of responses to achieve the required reduction in employee exposure. The employer may use feasible engineering controls, work practices, personal protective equipment, and respirators as necessary to achieve the required degree of protection. This is substantially different from the requirement in existing OSHA permanent standards. In the permanent standards, there is a hierarchy, requiring maximal use of engineering controls, and work practices, and allowing respirators and personal protection only where all other feasible means fail to control exposure.

Some fundamental and easily implemented work practices are specifically prescribed elsewhere in the ETS: i.e., limiting access to work areas to authorized personnel; prohibiting smoking and eating in work areas where there is a potential for exposure to AN above the permissible exposure limits; and housekeeping and maintenance to reduce the amounts of potentially hazardous material that may be present in the workplace.

The ETS also requires employers to prepare a plan for the reduction of employee exposure to the lowest feasible level solely by engineering and work practice methods, within 90 days of the issuance of the ETS. While the ETS will be in effect for only a brief time, and a full public proceeding must precede the issuance of a permanent standard, OSHA believes it is necessary to begin planning now for employee protection in the long term. Because of the general irreversibility of cancer, as pointed out above, OSHA considers the early reduction of employee exposures the most significant provision in decreasing the gravity of the health risk.

7. *Paragraph (h)—Respiratory protection.* The ETS provides that where respirators are necessary to limit employee exposures to below the permissible exposure limits, the employer must provide, at no cost to the employee, and assure that the employees use respirators. The ETS contains a respirator selection table (Table 1) so the employer will provide the type of respirator which affords the proper degree of protection based on the airborne concentrations of acrylonitrile to which the employee may be exposed for protection against vapors and gases. In addition, the requirements of the table closely parallel the recommendations which have been received in the record from several major companies having considerable experience with AN.

Most companies working with AN have long been aware of the high acute toxicity of this chemical, and many have developed respiratory protection programs to deal with the acute exposure hazard. OSHA has determined, on the basis of information in the record concerning these ongoing respirator programs and recommendations as to appropriate requirements for respiratory protection, that the provisions in the ETS concerning respirators should pose no undue burden to companies in their compliance efforts, particularly in light of the ready availability of the prescribed equipment.

Since AN has no warning properties at concentrations where the use of air-purifying respirators is permitted, and because these respirators have no end-of-service indicator, the ETS requires that the cartridges or canisters be replaced at the end of each workshift in which they are first used. Special care must be taken in their use to assure proper fitting.

The ETS requires that the employee be properly trained to wear the respirator, to know why the respirator is needed, and to understand the limitations of the respirator. An understanding of the hazards involved is necessary to enable the employee to take steps for his or her own protection. The respiratory protection program implemented by the employer must conform with 29 CFR 1910.134. This section contains the basic requirements for use, cleaning, and maintenance of respirators.

To prevent skin irritation and to minimize the discomfort of respirator use, the ETS requires that employees must be allowed to periodically wash their faces and respirator facepieces to reduce the chance of irritation from the wearing of the facepiece, and to remove any AN which may have accumulated on the facepiece. This provision is included because of the fact that AN is easily absorbed through the skin, and if it is held against the

skin for any prolonged period, it can cause irritation and blistering.

Finally, the ETS requires that respirators and other clothing and equipment required for protection from exposure to AN shall be provided at no cost to the employee. OSHA views this allocation of costs to control employee exposure to AN as being necessary to effectuate the purposes of the Act. The requirement makes explicit an agency position which has long been implicit in health standards proceedings under section 6(b) of the Act.

8. *Paragraph (j)—Protective clothing and equipment.* The ETS requires the employer to provide, at no cost to the employee, and assure that employees who are subject to skin or eye contact with AN use impermeable protective clothing or equipment such as goggles in order to minimize these hazards.

The ETS also requires that the employer clean, launder, or dispose of the required protective clothing to eliminate any potential exposure to AN that might result were the clothing to be laundered by the employee, at home or in a commercial laundry.

The ETS also requires that protective clothing be provided in a clean and dry condition at least weekly. Since skin contact with AN creates a potential for skin absorption and serious irritation and/or dermatitis, OSHA believes that the regular cleaning of contaminated work clothing plays an important part in the prevention of the exposure hazard. The ETS also requires that protective clothing and equipment be maintained and replaced by the employer as needed in order to ensure effectiveness.

In addition, since leather is known to absorb acrylonitrile readily, the protective clothing requirements of the standard will necessarily include the supplying of impermeable shoecovers to employees who may come into contact with liquid AN.

The ETS provides that the employer assure that all protective clothing is removed at the end of each workshift. In addition, whenever protective clothing becomes wet with liquid acrylonitrile the employer shall assure that the employee remove that clothing promptly to avoid skin contact. The employer is also required to assure that the clothing that is to be laundered, cleaned, or disposed of be placed in a closeable container. The purpose of requiring such a container is to prevent the contaminants on the clothing from being released into the ambient air or from being contacted by an individual handling the container.

Finally, the ETS requires employers to inform those who handle the contaminated protective clothing of the potential harmful effects of exposure to acrylonitrile. This provision is designed to make clear the need to use proper care in handling of the contaminated protective clothing.

9. *Paragraph (k)—Housekeeping.* Removal and prevention of accumulations of liquid acrylonitrile or polymer containing residual acrylonitrile on all surfaces are important requirements in the ETS and are necessary to minimize employee exposure. When AN is in liquid or vapor form, all containers or vessels are required by the ETS to be enclosed to the maximum extent feasible, and tightly covered when not in use. Appropriate measures are to be taken to assure that compliance with this provision does not result in a fire or explosion hazard from AN.

10. *Paragraph (l)—Waste disposal.* For disposal of waste scrap or equipment or debris containing AN monomer, the standard requires that such material be collected and disposed of in sealed or closed containers which prevent the dispersion of AN outside the containers. State environmental protection agencies designate appropriate landfills for the disposal of such waste.

11. *Paragraph (m)—Hygiene facilities and practices.* Section 1910.141 prescribes hygiene facilities and practices required in all workplaces for ordinary sanitary protection. In addition, it includes provisions applicable where toxic substances are handled, for appropriate facilities and practices. While § 1910.141 is a separately applicable provision in OSHA regulations, attention is directed to it by specifically referring to it in this ETS.

Change rooms as specified in § 1910.141(e) are not required where the employer can demonstrate that such facilities, if not already available, cannot be provided before the expiration of this standard. However, § 1910.141(e) requires change rooms wherever personal protective clothing is required. Personal protective clothing has been required in certain industries, such as AN monomer production under sections 1910.132 and 1910.133 for some time. The ETS does not diminish these pre-existing obligations in any way.

12. *Paragraph (n)—Medical surveillance.* The standard requires that each employer institute a medical surveillance program for all employees who are, or will be exposed to AN above the action level. OSHA believes that a medical surveillance program is necessary in dealing with the problem of employee exposure to AN; hence, pursuant to the Act, this standard has prescribed it. The authority, indeed, the requirement, to include medical surveillance in an OSHA standard is found in section 6(b)(7) of the Act:

> • • • where appropriate, any such standard promulgated under subsection 6(b) shall prescribe the type and frequency of medical examinations or other tests which shall be made available, by the employer or at his cost, to employees exposed to such employment related hazards in order to most effectively determine whether the health of such employees is adversely affected by such exposure.

The ETS requires that the medical surveillance program provide each covered employee with an opportunity for medical examination.

All examinations and procedures are required to be performed by or under the supervision of a licensed physician, and provided without cost to the employee. While the physician will usually be selected by the employer, the standard does not so mandate, leaving the employer free to institute alternative procedures such as joint selection with the employee or selection by the employee. Clearly, a licensed physician is the appropriate person to be conducting a medical examination. However, certain parts of the required examination (e.g., taking of a history) do not necessarily require a physician's expertise and may be conducted by another person under the supervision of the physician. As noted above, the Congress has mandate, by reason of section 6(b)(7) of the Act, the medical examinations and procedures required by OSHA Standards be provided at no cost to the employee.

The ETS requires that the medical examination include a work history, a medical history, and a physical examination of the affected employees. The content of the examination is based upon recommendations from NIOSH, and upon procedures followed by several companies at present in their clinical evaluation of employees exposed to acrylonitrile. The purpose of these requirements is to make an initial medical assessment of each employee and to establish a baseline health condition against which future changes in an employee's health may be compared.

The medical surveillance provisions of the ETS contain specific testing requirements, with concentration on the central nervous system, respiratory system, and gastrointestinal system. Based upon the data from the duPont and MCA studies of exposure to AN, these vital sites must be considered to be possible target sites for cancer. OSHA believes that these provisions will enable the examining physician to detect, and hopefully, provide early treatment for any cancers which may develop due to past exposures to AN.

The standard requires that the employer provide the physician with certain information. This includes the following: (1) A copy of the regulation; (2) a description of the affected employee's duties as they relate to the employee's exposure; (3) the results of the employee's exposure monitoring; (4) whether any personal protective equipment has been or will be used; and (5) information from previous

medical examinations of the affected employee to the extent that they are not readily available to the physician. The purpose of making this information available to the physician is to aid in the evaluation of the employee's health in relation to his assigned duties and fitness to wear personal protective equipment when required.

The employer is required to obtain a written opinion from the examining physician containing the following information: (1) The results of the medical tests; (2) the physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of health from exposure to AN; (3) any recommended limitations upon the employee's exposure to AN and upon the use of protective clothing and equipment, such as respirators; and (4) a statement that the employee has been informed by the physician in writing of the test results, and of any medical conditions which require further examination or treatment. This written opinion must not reveal specific findings or diagnoses unrelated to occupational exposure. A copy of the opinion must be provided to the affected employee by the employer.

The requirement that the employee be provided with a copy of the physician's written opinion will assure that the employee is informed of the results of the medical examination and may take any appropriate action. The purpose requiring that specific findings or diagnoses unrelated to occupational exposure not be included in the written opinion is to encourage employees to submit to medical examination by removing the fear that employers may find out information about their physical condition that has no relation to their occupational exposures.

13. *Paragraph (o). —Employee information and training.* The ETS requires the employer to provide a training program for employees exposed to AN. OSHA believes that an information and training program is essential for the protection of employees, because an employee can do much to protect himself if aware of the nature of the hazards in the workplace. To be effective, an employee education system must, at the minimum, apprise the employee of the specific hazards associated with his or her work environment. For this reason, the employer is required to inform each employee exposed to AN of the nature of the related health problems, the necessity for exposure control, and the medical and industrial hygiene monitoring programs.

The content of the training program is intended to apprise the employees of several factors: (1) The hazards to which they are exposed; (2) the action they can take to protect themselves, including avoiding exposure, using respiratory protection and taking medical examinations; (3) their role in reducing exposures; and (4) the contents of the standard. Section 6(b)(7) of the Act makes it clear that these are appropriate goals of an employee training program, and the standard, therefore, includes such provisions.

The employer is also required to provide upon request, all materials relating to the training program to the Secretary and the Director. This is intended to provide an objective check of compliance with the requirements of the standard.

14. *Paragraph (p).—Signs and labels.* OSHA believes that it is important, and indeed, section 6(b)(7) of the Act provides, that appropriate forms of warnings be used as necessary, to apprise employees of the hazards to which they are exposed in the course of their employment. OSHA believes, as a matter of policy, that employees should be given the opportunity to make informed decisions as to whether or not to work at a job under the particular working conditions in effect. Furthermore, OSHA believes that since control of health and safety problems involves the cooperation of employees, the success of a program is highly dependent upon the employee's understanding of the hazards attendant to his or her job.

In light of the serious nature of the hazard of exposure to AN, OSHA does not believe that periodic training alone will adequately apprise employees of the health hazards of AN. However, OSHA does believe that the training requirements, when coupled with the requirement to post signs and labels, will adequately do so.

The standard requires that no statement which contradicts or detracts from the effect of any sign required by this paragraph shall appear on or near any such required sign.

Due to the hazardous nature of exposure to AN, OSHA believes that emphasis should be placed on warning employees and other persons about the danger of exposure. For this reason, the standard includes a requirement that caution labels be affixed to all containers containing AN and AN-based polymers, except for products which meet one of the conditions of paragraph (a)(2) of the standard. This requirement is provided not only because of the hazardous nature of such exposure, but because of the necessity for both the employer and employee to know whether the product contains acrylonitrile. The labeling provisions of the standard also require the employer to assure that caution labels are affixed to products containing acrylonitrile when these products leave the employer's workplace. This requirement is designed to protect any other employees who will be handling, transporting, or using this product. Thus, manufacturers and suppliers of acrylonitrile, intermediate polymers containing acrylonitrile, ABS and SAN plastics and resins, latexes, and other products containing AN would be required to affix caution labels to their products except as noted above. The rationale for this requirement is that the manufacturer or supplier is in the best position to know if the product contains AN and therefore, to warn other employers and their employees of the dangers involved.

15. *Paragraph (g).—Recordkeeping.* Section 8(c)(3) of the Act provides for the promulgation of regulations requiring employers to maintain accurate records of employee exposures to potentially toxic or harmful physical agents which are required to be monitored or measured.

The standard provides that records must be kept to identify the employee and to accurately reflect the employee's exposure. Specifically, it must include the following information: (a) The names, social security numbers, and job classifications of the employees monitored; (b) the dates, number, duration, and results of each of the samples taken, including a description of the representative sampling procedure and equipment used to determine employee exposure where applicable; (c) the type of respiratory protective devices if any, worn by the employee; and (d) a description of the sampling and analytical methods used, and evidence of their accuracy.

The ETS also requires that the employer keep an accurate medical record for each employee who is subject to medical surveillance. Section 8(c) of the Act authorizes the promulgation of regulations requiring any employer to keep such records regarding the employer's activities relating to the Act as are necessary or appropriate for the enforcement of the Act or for developing information regarding the causes and prevention of occupational illnesses. OSHA believes that medical records (like exposure monitoring records) are both necessary and appropriate to both the enforcement of the standard and the development of information regarding the causes and prevention of illness.

As explained above, it is necessary to relate employees' medical conditions with their exposures in order to develop information regarding cause and prevention. Medical records are necessary and appropriate for this purpose. In addition, medical records are necessary for the proper evaluation of an individual employee's health. For all of these reasons, medical records have been required in the ETS.

The ETS requires that employees or their designated representatives be provided access to examine and copy

records of required monitoring. The purpose of this provision is to assure current employees that their exposure is being properly monitored and that they are working in a safe and healthful environment. Section 8(c)(3) of the Act explicitly provides "employees or their representatives with an opportunity to observe * * * and to have access to the records thereof."

The ETS requires that employee medical records be made available upon request for examination and copying by the affected employee or former employee, or a physician by the affected employee or former employee. The purpose of this provision is to protect the employee's health by authorizing his designated physician to have access to medical records which may be useful in the diagnosis of illness.

16. *Paragraph (r).—Observation of monitoring.* Section 8(c)(3) of the Act requires that employers provide employees and their representatives with the opportunity to observe monitoring of employee exposures to toxic substances or harmful physical agents. In accordance with this section, the ETS contains provisions for such observation of monitoring of acrylonitrile exposures. To assure that the right to observe is meaningful, observers are entitled to receive an explanation of the measurement procedure, to observe all steps related to the measurement procedure, and to record the results obtained.

The observer, whether an employee or a designated representative, must be provided with, and is required to use, any personal protective equipment required to be worn by employees working in the area that is being monitored, and must comply with all other applicable safety and health procedures.

17. *Paragraph (s).—Effective date.* The ETS becomes effective upon publication. However, certain paragraphs do contain briefly delayed effective dates.

As noted earlier, some employers have already begun to carry out activities which are now to be required under the ETS, such as monitoring and medical surveillance. OSHA recognizes that the ETS might require repetition of steps that were taken only shortly before the standard became effective. To avoid such repetition, OSHA will recognize activities which are conducted within 30 days prior to the ETS as having been carried out under the ETS, if such activities were conducted in substantial compliance with the standard.

The Assistant Sectetary determines that all requirements under the new §1910.1045 are feasible. Most affected employers have already obtained, or have access to, the required personal protective equipment, respirators, and monitoring equipment for compliance with the ETS.

In fact, OSHA has been advised by Enviro Control, Inc., the contractor assessing the economic impact of an AN standard that all equipment, supplies and services expected to be necessary for compliance with the ETS are currently available from suppliers in sufficient quantities.

Several provisions require compliance as soon as possible, but no later than thirty (30) days from the effective date of the standard. This requires employers to take immediate steps to comply with these provisions, but recognizes that some employers may not be able to fully comply immediately. In any event, full compliance must be achieved by the end of the thirty-day time period. Examples of this are the medical surveillance and training sections of the standard. In addition, where specific elements of the medical examination, such as the chest x-ray, have been performed within the six (6) months prior to the effective date of this standard, those elements need not be repeated before the anniversary date. Furthermore, many of the requirements of the new standard are already required by other OSHA standards, such as the eye and face protection required under §1910.133, respiratory protection required under §1910.134, and sanitation requirements of §1910.141. Finally, any feasibility problems concerning the immediate effective date are mitigated by the following factors: (1) The fact that OSHA, in its notice in the FEDERAL REGISTER on June 29, 1977, indicated that the Agency was considering action on acrylonitrile, including the possibility of an emergency temporary standard; (2) the fact that NIOSH, on July 1, 1977, issued its "Current Intelligence Bulletin" on acrylonitrile, in which it recommended that OSHA regulate occupational exposure as a human carcinogen, and suggested work practices and other means of controlling exposures; (3) the fact that industry has been on notice of the interim results of the MCA animal studies since no later than April of 1977; (4) the fact that the duPont preliminary report on the epidemiological study of the Camden, S.C. fiber plant was available in late May of this year; (5) the fact that employers have long known of the hazardous nature of acrylonitrile, as well as of its chemical similarities to hydrogen cyanide and vinyl chloride; and (6) the fact that efforts are already underway in many companies manufacturing, processing, or using acrylonitrile to lower employee exposures through engineering and work practice changes and controls. Accordingly, employers have been apprised of the hazardous nature of acrylonitrile for a substantial period of time, and they have been aware of the need to provide protection, including respirators and other protective equipment.

18. *Paragraph (t)—Appendices.* The ETS includes three appendices: Appendix A, entitled "Substance Safety Data Sheet", Appendix B, entitled "Substance Technical Guidelines", and Appendix C, entitled "Medical Surveillance Guidelines". It should be noted that the appendices are for informational purposes only. None of the statements contained therein should be construed as imposing a mandatory requirement not in the ETS, nor should they be construed as negating any requirement which is included in the ETS.

The information in Appendix A is specifically written for the employee. Appendix B contains additional scientific and technical information to aid the employer in complying with requirements of the standard. Appendix C gives the employer a means of providing the examining physican with an explanation of the potential health effects of exposure to AN and provides information needed by the physician to evaluate the results of the medical examination. Appendix C also lists other types of examinations which are not specifically required by the ETS, but which may assist the physician in making an accurate determination of whether an employee should be exposed or should continue to be exposed to acrylonitrile.

19. *References.* The studies and other data listed below, as well as the additional material referred to in this document, represent the principal sources upon which the Emergency Temporary Standard is based. A complete set of the references is available for examination and copying at the OSHA Technical Data Center, Docket Office Room S6212, U.S. Department of Labor, Third Street and Constitution Avenue NW., Washington, D.C. 20210, between 8:30 am. and 4:30 pm. Monday through Friday, legal holidays excepted.

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### V. Public Participation—Notice of Hearing

Pursuant to section 6(c)(3) of the Act, this ETS as published also serves as a proposal for a permanent rule. A more comprehensive proposed permanent standard on occupational exposure to acrylonitrile has been developed, and is published elsewhere in today's edition of the Federal Register, at page ——. The proposal contains additional provisions and some modifications of this emergency temporary standard. The comprehensive proposed permanent standard is based on the emergency standard, but contains provisions which OSHA deems to be more suited to permanent regulation of acrylonitrile. The differences between the ETS and the proposed permanent standard are discussed in detail in the preamble to the proposed permanent standard.

The emergency nature of this proceeding and the requirements of section 6(c) of the Act will necessitate expedited treatment throughout the development of the final standard on acrylonitrile. Therefore, interested parties should begin preparation of their written comments and oral presentations immediately.

Interested persons are invited to submit written data, views, and arguments with respect to this ETS and the proposed permanent standard. These comments must be postmarked on or before February 21, 1978, and submitted in quadruplicate to the Docket Officer, Docket No. H-108, Room S6212, U.S. Department of Labor, Third Street and Constitution Avenue NW. Washington, D.C. 20210. Written submissions must clearly identify the provisions of the ETS and the proposal which are addressed and the position taken with respect to each issue.

The data, views, and arguments that are submitted will be available for public inspection and copying at the above address. All timely written submissions will be made a part of the record of this proceeding.

Pursuant to section 6(b)(3) of the Act, an opportunity to submit oral testimony concerning the issues raised by the ETS and the proposed standard including economic and environmental impacts, will be provided at an informal public hearing scheduled to begin at 9:30 A.M. on March 21, 1978, in the New Department of Labor Auditorium, New Department of Labor Building, Third Street and Constitution Avenue, NW., Washington, D.C. 20210.

NOTICES OF INTENTION TO APPEAR

All persons desiring to participate at the hearing must file in quadruplicate a notice of intention to appear, postmarked on or before February 27, 1978, addressed to Mr. Clarence Page, OSHA Division of Consumer Affairs, Docket No. H-108, Room N-3635, U.S. Department of Labor, Third Street and Constitution Avenue NW., Washington, D.C. 20210; telephone 202-523-8024.

The notices of intention to appear, which will be available for inspection and copying at the OSHA Technical Data Center—Docket Office (Room S6212), telephone 202-523-7895, must contain the following information:

(1) The name, address, and telephone number of each person to appear;

(2) The capacity in which the person will appear;

(3) The approximate amount of time requested for the presentation;

(4) The specific issues that will be addressed;

(5) A detailed statement of the position that will be taken with respect to each issue addressed; and

(6) Whether the party intends to submit documentary evidence, and if so, a brief summary of that evidence.

FILING OF TESTIMONY AND EVIDENCE BEFORE HEARING

Any party requesting more than 15 minutes for a presentation at the hearing, or who will submit documentary evidence, must provide in quadruplicate the complete text of his testimony, including any documentary evidence to be presented at the hearing, to the OSHA Division of Consumer Affairs. This material must be received by March 7, 1978, and will be available for inspection and copying at the Technical Data Center—Docket Office. Each such submission will be reviewed in light of the amount of time requested in the notice of intention to appear. In those instances where the information contained in the submission does not justify the amount of time requested, a more appropriate amount of time will be allocated and the participant will be notified of that fact.

Any party who has not substantially complied with this requirement may be limited to a 15-minute presentation, and may be requested to return for questioning at a later time.

CONDUCT OF HEARINGS

The hearing will commence at 9:30 A.M. on Tuesday, March 21, 1978, with resolution of any procedural matters relating to the proceeding. The hearing will be conducted in accordance with 29 CFR Part 1911. In view of the emergency nature of this rulemaking proceeding, the hearing will be conducted in as expedited a manner as possible with a full development of the record and the rights of the parties.

The hearing will be presided over by an Administrative Law Judge who will have all the powers necessary or appropriate to conduct a full and fair informal hearing as provided in 29 CFR Part 1911. Following the close of the hearing or of any posthearing comment period, the presiding Administrative Law Judge will certify the record to the Assistant Secretary of Labor for Occupational Safety and Health. The proposed permanent standard will be reviewed in light of all oral and written submissions received as part of the record, and a permanent standard for occupational exposure to acrylonitrile will be issued, based upon the entire record in this proceeding.

AUTHORITY

This document was prepared under the direction of Eula Bingham, Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, Third Street and Constitution Avenue NW., Washington, D.C. 20210.

Accordingly, pursuant to sections 6(c) and 8(c) of the Occupational Safety and Health Act of 1970 (84 Stat. 1596, 1599, 29 U.S.C. 655, 657), the Secretary of Labor's Order No. 8-76 (41 FR 25059), and 29 CFR 1911, Part 1910 of Title 29, Code of Federal Regulations is hereby amended by adding a new § 1910.1045 as set forth below.

In addition, pursuant to section 4(b)(2) of the Act (84 Stat. 1592; 29 U.S.C. 653), the standard in the new § 1910.1045 is determined to be more effective than the corresponding standards now in Subpart B of Part 1910, in Parts 1915, 1916, 1917, 1918, and 1926 of Title 29 Code of Federal Regulations. Therefore, these corresponding Standards are superseded by the new standard in § 1910.1045. These amendments are effective January 17, 1978.

Signed at Washington, D.C., this 12th day of January, 1978.

EULA BINGHAM,
*Assistant Secretary of Labor.*

Part 1910 of Title 29 of the Code of Federal Regulations is therefore amended as follows:

1. Section 1910.19 is amended by adding a new paragraph (c) as follows:

**§ 1910.19 Special provisions for air contaminants.**

* * * * *

(c) *Acrylonitrile.* Section 1910.1045 shall apply to the exposure of every employee to acrylonitrile in every employment and place of employment covered by § 1910.12, § 1910.13, § 1910.14, § 1910.15; or § 1910.16, in lieu of any different standard on exposure to acrylonitrile which would otherwise be applicable by virtue of any of those sections.

**§ 1910.1000 [Amended].**

2. Section 1910.1000 is amended by deleting the line "Acrylonitrile——— 20———45" from Table Z-1 of that section.

3. A new 1910.1045, is added, to read as follows:

**§ 1910.1045 Acrylonitrile.**

(a) *Scope and application.* (1) This section applies to all occupational exposures to acrylonitrile (AN), Chemical Abstracts Service Registry No. 000107131, except as provided in paragraph (a)(2) of this section.

(2) This section does not apply to the processing, use, and handling of products fabricated from polyacrylonitrile (PAN) where objective data is reasonably relied upon as to one of the following conditions:

(i) That the material to be processed is not capable of releasing AN in airborne concentrations in excess of 1 ppm under expected conditions of processing, use, and handling which will cause the greatest possible release; or

(ii) That the material to be processed is not a latex or other liquid mixture and will not be heated or melted during the fabrication process.

(3) Where the processing, use and handling of products fabricated from PAN are exempted under this paragraph the employer shall maintain records of the objective data supporting that exemption, as provided in paragraph (q) of this section.

(b) *Definitions.* "Acrylonitrile" or "AN" means acrylonitrile monomer, chemical formula $CH_2=CHCN$.

"Action level" means a concentration of AN of 1 ppm averaged over any eight (8)-hour period.

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

"Authorized person" means any person specifically authorized by the employer and whose duties require the person to be present in areas where AN concentrations exceed the permissible exposure limit and any person entering this area as a designated representative of employees exercising an opportunity to observe employee exposure monitoring under paragraph (r) of this section.

"Director" means the Director, National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare, or designee.

"OSHA Area Office" means the Area Office of the Occupational Safety and Health Administration having jurisdiction over the geographic area where the affected workplace is located.

"Polyacrylonitrile" or "PAN" means polyacrylonitrile homopolymer or copolymer, except for materials as exempted under paragraph (a)(2) or of this section.

(c) *Permissible exposure limit.*—(1) *Inhalation.*—(i) *Time-weighted average limit (TWA).* As soon as possible, but no later than thirty (30) days from the effective date of this emergency temporary standard, the employer shall assure that no employee is exposed to an airborne concentration in excess of 2 parts AN per million parts of air (2 ppm), as an 8-hour time-weighted average.

(ii) *Ceiling limit.* As soon as possible, but no later than thirty (30) days from the effective date of this emergency temporary standard, the employer shall assure that no employee is exposed to an airborne concentration in excess of 10 parts AN per million parts of air (10 ppm) as averaged over any 15 minutes during the working day.

(2) *Dermal and eye exposure.* As soon as possible, but no later than thirty (30) days from the effective date of this emergency temporary standard, the employer shall assure that no employee is exposed to skin contact or eye contact with liquid AN, or with PAN.

(d) *Notification of use.* Within thirty (30) days of the effective date of this section or within fifteen (15) days following the introduction of AN into the workplace, every employer who has a workplace where AN is present shall report the following information to the nearest OSHA Area Office for each such workplace: (1) The address and location of each workplace in which AN is present;

(2) A brief description of each process or operation which may result in employee exposure to AN;

(3) The number of employees engaged in each process or operation who may be exposed to AN and an estimate of the frequency and degree of exposure that occurs; and

(4) A brief description of the employer's safety and health program as it relates to limitation of employee exposure to AN.

(e) *Exposure monitoring.*—(1) *General.* Determinations of airborne exposure levels shall be made from air samples that are representative of each employee's exposure to AN over an 8-hour period. (For the purposes of this section, employee exposure is that which would occur if the employee were not using a respirator.)

(2) *Initial monitoring.* As soon as possible, but not later than thirty (30) days after the effective date of this section, each such employer who has a place of employment in which AN is present shall monitor each such workplace and work operation to accurately determine the airborne concentrations of AN to which employees may be exposed. Such monitoring may be done on a representative basis, provided that the employer can demonstrate that these determinations are representative of employee exposures.

(3) *Frequency.* (i) If the monitoring required by this section reveals employee exposure to be below the action level, the employer may discontinue monitoring for that employee.

(ii) If the monitoring required by this section reveals employee exposure to be at or above the action level but below the permissible exposure limits, the employer shall repeat such monitoring for each such employee within three months.

(iii) If the monitoring, required by this section, reveals employee exposure to be in excess of the permissible exposure limits, the employer shall repeat these determinations for each such employee at least monthly. The employer shall continue these monthly measurements until at least two consecutive measurements, taken at least seven (7) days apart, are below the permissible exposure limits, and thereafter the employer shall monitor within three months.

(4) *Additional monitoring.* Whenever there has been a production, process, control, or personnel change which may result in new or additional exposures to AN, or whenever the employer has any other reason to suspect a change which may result in new or additional exposures to AN, additional monitoring which complies with this paragraph shall be conducted.

(5) *Employee notification.* (i) Within five (5) working days after the receipt of monitoring results, the employer shall notify each employee in writing of the results which represent that employee's exposure.

(ii) Whenever the results indicate that the representative employee exposure exceeds the permissible exposure limits, the employer shall include in the written notice a statement that the permissible exposure limits were exceeded and a description of the corrective action being taken to reduce exposure to or below the permissible exposure limits.

(6) *Accuracy of measurement.* The method of measurement shall be accurate, to a confidence level of 95 percent, to within plus or minus 25 percent for concentrations of AN at or above the permissible exposure limits, and to within plus or minus 35 percent for concentrations between the action level and the permissible exposure limits.

(f) *Regulated areas.* [Reserved]

(g) *Methods of compliance.*—(1) *General.* Employee exposures to AN shall be controlled to or below the permissible exposure limits by any practicable combination of engineering controls, work practices, and personal protective devices and equipment, during the effective period of this emergency temporary standard.

NOTE.—Where engineering controls or work practices can reduce employee exposures to AN, it is recommended that they be implemented where practicable, even where they do not themselves reduce employee exposures to, or below the permissible exposure limits. Work practices which can be implemented by the employer to help reduce employee exposures to AN include limiting access to work areas to authorized personnel, prohibiting smoking and consumption of food and beverages in work areas, and establishing good maintenance and housekeeping practices, including the prompt clean-up of spills and repair of leaks.

(2) *Engineering and work-practice control plan.* (i) Within ninety (90) days of the effective date of this emergency temporary standard, the employer shall develop a written plan describing proposed means to reduce employee exposures to AN to the lowest feasible level solely by means of engineering and work-practice controls.

(ii) Written plans required under this paragraph shall be submitted upon request to the Secretary and the Director, and shall be available at the worksite for examination and copying by the Assistant Secretary, Director, and any affected employee or designated representative.

(h) *Respiratory protection.*—(1) *Required use.* The employer shall assure that respirators are used where required under this section to reduce employee exposure to within the permissible exposure limits, and in emergencies.

(2) *Respirator selection.* (i) Where respiratory protection is required or permitted under this section, the employer shall select and provide at no cost to the employee, the appropriate respirator from Table I below, and shall assure that the employee wears the respirator provided. Respirators assigned for higher concentrations may also be used for lower concentrations.

(ii) The employer shall select respirators from among those approved for use with organic vapors by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 30 CFR Part 11.

TABLE 1.—*Respiratory protection for acrylonitrile (AN)*

| *Concentration of AN or condition of use* | *Respirator type* |
|---|---|
| (a) Less than or equal 20 p/m. | (1) Any chemical cartridge respirator with organic vapor cartridge and half-mask; or<br>(2) Any supplied air respirator with half-mask. |
| (b) Less than or equal to 100 p/m. | (1) Any organic vapor gas mask; or<br>(2) Any supplied air respirator with full facepiece; or<br>(3) Any self-contained breathing apparatus with full facepiece. |

TABLE 1.—*Respiratory protection for acrylonitrile (AN)*—Continued

| *Concentration of AN or condition of use* | *Respirator type* |
|---|---|
| (c) Less than or equal to 4,000 p/m. | (1) Supplied air respirator in positive pressure mode with full facepiece, helmet, hood, or suit. |
| (d) Less than or equal to 20,000 p/m. | (1) Supplied air respirator and auxiliary self-contained full facepiece in positive pressure mode; or<br>(2) Open circuit self-contained breathing apparatus with full facepiece in positive pressure mode. |
| (e) Emergency entry into unknown concentrations or fire fighting. | (1) Any self-contained breathing apparatus with full facepiece in positive pressure mode. |
| (f) Escape | (1) Any organic vapor gas mask; or<br>(2) Any self-contained breathing apparatus with full facepiece. |

(3) *Respirator program.* (i) The employer shall institute a respiratory protection program in accordance with 29 CFR 1910.134(b), (d), (e), and (f).

(ii) Where air-purifying respirators (chemical cartridge or canister-type gas mask) are used, the air-purifying canister or cartridge(s) shall be replaced prior to the expiration of their service life or at the beginning of each shift, whichever occurs first. A label shall be attached to the cartridge or canister to indicate the date and time at which it is first installed on the respirator.

(iii) The employer shall allow each employee who uses a filter respirator (cartridge or canister) to change the filter elements whenever an increase in breathing resistance is detected and shall maintain an adequate supply of filter elements for this purpose.

(iv) Employees who wear respirators shall be allowed to wash their faces and respirator facepieces to prevent potential skin irritation associated with respirator use.

(i) *Emergency situation.* [Reserved]

(j) *Protective clothing and equipment.*—(1) *Provision and use.* Where eye or skin contact with liquid AN or with PAN may occur, the employer shall provide at no cost to the employee, and assure that employees wear, appropriate protective clothing or other equipment in accordance with §§ 1910.132 and 1910.133 to protect any area of the body which may come in contact with liquid AN or with PAN.

(2) *Cleaning and replacement.* (i) The employer shall clean, launder, maintain, or replace protective clothing and equipment required by this paragraph as needed to maintain their effectiveness. In addition, the employer shall provide clean protective clothing and equipment at least weekly to each affected employee.

(ii) The employer shall assure that the employee removes all protective clothing and equipment at the completion of a workshift, and that an employee whose protective clothing becomes wet with liquid AN removes that clothing promptly to avoid skin contact with the liquid AN.

(iii) The employer shall assure that AN-contaminated protective work clothing and equipment is placed and stored in closable containers which prevent dispersion of AN outside the container.

(iv) The employer shall inform any person who launders or cleans AN-contaminated protective clothing or equipment of the potentially harmful effects of exposure to AN.

(v) The employer shall assure that the containers of contaminated protective clothing and equipment which are to be removed from the workplace for any reason are labeled in accordance with paragraph (p)(3)(ii) of this section and that such label remains affixed when such containers leave the employer's workplace.

(k) *Housekeeping.*—(1) *Surface.* (i) All surfaces shall be maintained free of accumulations of liquid of AN and of PAN.

(ii) Dry sweeping and the use of compressed air for the cleaning of floors and other surfaces where liquid AN and PAN are found is prohibited.

(iii) Where vacuuming methods are selected, either portable units or a permanent system may be used.

(A) If a portable vacuum unit is selected, the exhaust shall be attached to the general workplace exhaust ventilation system or collected within the vacuum unit, equipped with high efficiency filters or other appropriate means of contaminant removal, so that AN is not reintroduced into the workplace air; and

(B) Portable vacuum units used to collect AN may not be used for other cleaning purposes and shall be labeled as prescribed by paragraph (p)(3)(ii) of this section.

(iv) Cleaning of floors and other contaminated surfaces may not be performed by washing down with a hose, unless a fine spray has first been laid down.

(2) *Liquids.* Where AN is present in a liquid form, or as a resultant vapor, all containers or vessels containing AN shall be enclosed to the maximum extent feasible and tightly covered when not in use, with adequate provision made to avoid any resulting potential explosion hazard.

(l) *Waste disposal.* AN and PAN waste, scrap, debris, bags, containers or equipment shall be disposed of in sealed bags or other closed containers which prevent dispersion of AN outside the container, and labelled as prescribed in paragraph (p)(3)(ii) of this section.

(m) *Hygiene facilities and practices.* Where employees are exposed to airborne concentrations of AN above the permissible exposure limits, or where employees are required to wear protective clothing or equipment pursuant to paragraph (j) of this section, or where otherwise found to be appropriate, the facilities required by 29 CFR 1910.141 shall be provided by the employer for the use of those employees, and the employer shall assure that the employees use the facilities provided. Change rooms as specified in § 1910.141(c) are not required where the employer can demonstrate that such facilities, if not already available, cannot be feasibly provided before the expiration of this standard. This provision does not in any way diminish pre-existing obligations to provide change rooms.

(n) *Medical surveillance.*—(1) *General.* (i) The employer shall institute a program of medical surveillance for each employee who is or will be exposed to AN above the action level. The employer shall provide each such employee with an opportunity for medical examinations and tests in accordance with this paragraph.

(ii) The employer shall assure that all medical examinations and procedures are performed by or under the supervision of a licensed physician, and shall be provided without cost to the employee.

(2) *Initial examinations.* Within thirty (30) days of the effective date of this section, or thereafter at the time of initial assignment, the employer shall provide each affected employee an opportunity for a medical examination, including at least the following elements:

(i) A work history and medical history with special attention to skin, respiratory, and gastrointestinal systems, and those non-specific symptoms, such as headache, nausea, vomiting, dizziness, weakness, or other central nervous system dysfunctions that may be associated with acute or with chronic exposure to AN.

(ii) A physical examination giving particular attention to the central nervous system, gastrointestinal system, respiratory system, skin, and thyroid.

(iii) A 14" x 17" posteroanterior chest X-ray.

(iv) Further tests of the intestinal tract, including fecal occult blood and proctosigmoidoscopy, on all workers 40 years of age or older and to any other affected employees for whom, in the opinion of the physician, such testing would be appropriate.

(3) *Periodic examinations.* [Reserved]

(4) *Interim examinations.* If the employee for any reason develops signs or symptoms commonly associated with exposure to AN, the employer shall provide appropriate examination and emergency medical treatment.

(5) *Information provided to the physician.* The employer shall provide the

following information to the examining physician:

(i) A copy of this emergency temporary standard and its appendices;

(ii) A description of the affected employee's duties as they relate to the employee's exposure;

(iii) The employee's representative exposure level; and

(iv) A description of any personal protective equipment used or to be used.

(6) *Physician's written opinion.* (i) The employer shall obtain a written opinion from the examining physician which shall include:

(A) The results of the medical test performed;

(B) The physician's opinion as to whether the employee has any detected medical condition which would place the employee at an increased risk of material impairment of the employee's health from exposure to AN;

(C) Any recommended limitations upon the employee's exposure to AN or upon the use of protective clothing and equipment such as respirators; and

(D) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

(ii) The employer shall instruct the physician not to reveal in the written opinion specific findings or diagnoses unrelated to occupational exposure to AN.

(iii) The employer shall provide a copy of the written opinion to the affected employee.

(o) *Employee information and training.*—(1) *Training program.* (i) As soon as possible but no later than thirty (30) days from the effective date of this standard, the employer shall institute a training program for all employees where there is occupational exposure to AN and shall assure their participation in the training program.

(ii) The employer shall assure that each employee is informed of the following:

(A) The information contained in Appendices A, B and C;

(B) The quantity, location, manner of use, release or storage of AN and the specific nature of operations which could result in exposure to AN, as well as any necessary protective steps;

(C) The purpose, proper use, and limitations of respirators;

(D) The purpose and a description of the medical surveillance program required by paragraph (n) of this section; and

(E) A review of this standard.

(2) *Access to training materials.* (i) The employer shall make a copy of this standard and its appendices readily available to all affected employees.

(ii) The employer shall provide, upon request, all materials relating to the employee information and training program to the Assistant Secretary and the Director.

(p) *Signs and labels.*—(1) *General.*

(i) The employer may use labels or signs required by other statutes, regulations, or ordinances in addition to, or in combination with, signs and labels required by this paragraph.

(ii) The employer shall assure that no statement appears on or near any sign or label, required by this paragraph, which contradicts or detracts from such effects of the required sign or label.

(2) *Signs.* (i) The employer shall post signs to clearly indicate all workplaces where AN concentrations exceed the permissible exposure limits. The signs shall bear the following legend:

DANGER

ACRYLONITRILE (AN)

CANCER HAZARD

AUTHORIZED PERSONS ONLY

RESPIRATORS REQUIRED

(ii) The employer shall assure that signs required by this paragraph are illuminated and cleaned as necessary so that the legend is readily visible.

(3) *Labels.* (i) The employer shall assure that precautionary labels are affixed to all containers of AN, and to containers of PAN and products fabricated from PAN except for those materials for which objective data is provided as to the conditions specified in (a)(2) of this section. The employer shall assure that these labels remain affixed when the AN, PAN and products fabricated from PAN are sold, distributed or otherwise leave the employer's workplace.

(ii) The employer shall assure that the precautionary labels required by this paragraph are readily visible and legible. The labels shall bear the following legend:

DANGER

CONTAINS ACRYLONITRILE (AN)

CANCER HAZARD

(q) *Recordkeeping.*—(1) *Objective data for exempted operations.* (i) where the processing, use, and handling of products fabricated from PAN are exempted pursuant to paragraph (a)(2) of this section, the employer shall establish and maintain an accurate record of all objective data reasonably relied upon in support of the exemption.

(ii) This record shall include the following information:

(A) The relevant condition in paragraph (a)(2) upon which exemption is based;

(B) The source of the objective data;

(C) The results of testing and analysis of the material being processed;

(D) A description of the operation exempted; and

(E) Other data relevant to the operation, materials, and processing covered by the exemption.

(iii) The employer shall maintain this record for the duration of the employer's reliance upon such objective data.

(2) *Exposure monitoring.* (i) The employer shall establish and maintain an accurate record of all monitoring required by paragraph (e) of this section.

(ii) This record shall include:

(A) The dates, number, duration, and results of each of the samples taken, including a description of the sampling procedure used to determine representative employee exposure;

(B) A description of the sampling and analytical methods used;

(C) Type of respiratory protective devices worn, if any; and

(D) Name, social security number, and job classification of the employee monitored and of all other employees whose exposure the measurement is intended to represent.

(iii) The employer shall maintain this record for the effective period of this emergency temporary standard, and for any additional period required by the permanent standard.

(3) *Medical surveillance.* (i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance as required by paragraph (n) of this section.

(ii) This record shall include:

(A) A copy of the physicians' written opinions;

(B) Any employee medical complaints related to exposure to AN;

(C) A copy of the information provided to the physician as required by paragraph (n)(6) of this section; and

(D) A copy of the employee's work history.

(iii) The employer shall assure that this record be maintained for the effective period of this emergency temporary standard, and for any additional period required by the permanent standard.

(4) *Availability.* (i) The employer shall assure that all records required to be maintained by this section be made available upon request to the Assistant Secretary and the Director for examination and copying.

(ii) The employer shall assure that employee exposure measurement records, as required by this section, be made available, upon request, for examination and copying to the affected employee, former employee, or designated representative.

(iii) The employer shall assure that employee medical records required to be maintained by this section, be made available, upon request, for examination and copying to the affected em-

ployee or former employee, or to a physician designated by the affected employee, former employee, or designated representative.

(r) *Observation of monitoring.*—(1) *Employee observation.* The employer shall provide affected employees, or their designated representatives, an opportunity to observe any monitoring of employee exposure to AN conducted pursuant to paragraph (e) of this section.

(2) *Observation procedures.* (i) Whenever observation of the monitoring of employee exposure to AN requires entry into an area where the use of protective clothing or equipment is required, the employer shall provide the observer with personal protective clothing or equipment required to be worn by employees working in the area, assure the use of such clothing and equipment, and require the observer to comply with all other applicable safety and health procedures.

(ii) Without interfering with the monitoring, observers shall be entitled:

(A) To receive an explanation of the measurement procedures;

(B) To observe all steps related to the measurement of airborne concentrations of AN performed at the place of exposure; and

(C) To record the results obtained.

(s) *Effective date.* This section shall become effective immediately.

(t) *Appendices.* The information contained in the appendices is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligations.

## APPENDIX A.—SUBSTANCE SAFETY SHEET FOR ACRYLONITRILE

### I. SUBSTANCE IDENTIFICATION

A. Substance: Acrylonitrile ($CH_2=CHCN$).

B. Synonyms: Propenenitrile; vinyl cyanide; cyanoethylene; AN; VCN; acrylon; carbacryl; fumigrain; ventox.

C. Acrylonitrile can be found as a liquid or vapor, and can also be found in polymer resins, plastics, polyols, and other polymers having acrylonitrile as a raw or intermediate material.

D. AN is used in the manufacture of acrylic and modacrylic fibers, acrylic plastics and resins, specialty polymers, nitrile rubbers, and other organic chemicals. It has also been used as a fumigant.

E. Appearance and Odor: Colorless to pale yellow liquid with a pungent odor which can only be detected at concentrations above the permissible exposure level, in a range of 13-19 parts AN per million parts of air (13-19 ppm).

F. Permissible Exposure: Exposure may not exceed either:

1. 2 parts AN per million parts of air (2 ppm) averaged over the eight-hour workday; or

2. 10 parts AN per million parts of air (10 ppm) averaged over any 15-minute period in the workday.

3. In addition, skin and eye contact with liquid AN is prohibited.

### II. HEALTH HAZARD DATA

A. Acrylonitrile can affect your body if you inhale the vapor (breathing) if it comes in contact with your eyes or skin, or if you swallow it. It may enter your body through your skin.

B. Effects of Overexposure:

1. Short-term Exposure: Acrylonitrile causes eye irritation, nausea, vomiting, headache, sneezing, weakness, and lightheadedness. At high concentrations, the effects of exposure may go on to loss of consciousness and death. When acrylonitrile is held in contact with the skin after being absorbed into shoe leather or clothing, it may produce blisters following several hours of no apparent effect. Unless the shoes or clothing are removed immediately and the area washed, blistering will occur. Usually there is no pain or inflammation associated with blister formation.

2. Long-term Exposure: Acrylonitrile has been shown to cause cancer in laboratory animals and has been associated with higher incidences of cancer in humans. Repeated or prolonged exposure of the skin to acrylonitrile may produce irritation and dermatitis.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms which may be caused by exposure to acrylonitrile.

### III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If acrylonitrile gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If acrylonitrile gets on your skin, immediately wash the contaminated skin with water. If acrylonitrile soaks through your clothing, especially your shoes, remove the clothing immediately and wash the skin with water. If symptoms occur after washing, get medical attention immediately. Thoroughly wash the clothing before re-using. Contaminated leather shoes or other leather articles should be discarded.

C. Inhalation: If you or any other person breathes in large amounts of acrylonitrile, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

D. Swallowing: When acrylonitrile has been swallowed, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

E. Rescue: Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the emergency equipment before the need arises.

F. Special First Aid Procedures: First aid kits containing an adequate supply (at least two dozen) of amyl nitrite pearls (ampules), each containing 0.3 ml, should be maintained at each site where acrylonitrile is used. When a person is suspected of receiving an overexposure to acrylonitrile, immediately remove that person from the contaminated area using established rescue procedures. Contaminated clothing must be removed and the acrylonitrile washed from the skin immediately. Artificial respiration should be started at once if breathing has stopped. If the person is unconscious, amyl nitrite may be used as an antidote by a properly trained individual in accordance with established emergency procedures. Medical aid should be obtained immediately.

### IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: You may be required to wear a respirator for non-routine activities, in emergencies, and while your employer is in the process of reducing acrylonitrile exposures through engineering controls. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required.

Acrylonitrile does not have a detectable odor except at levels above the permissible exposure limit. Do not depend on odor to warn you when a respirator cartridge or canister is exhausted. Cartridges or canisters must be changed daily. Reuse of these may allow acrylonitrile to gradually filter through the cartridge and cause exposures which you cannot detect by odor. If you can smell acrylonitrile while wearing a respirator, the respirator is not working correctly. Go immediately to fresh air. If you experience difficulty breathing while wearing a respirator tell your employer.

B. Supplied-air Suits: In some work situations, the wearing of supplied-air suits may be necessary. Your employer should instruct you in their proper use and operation.

C. Protective Clothing: You must wear impervious clothing, gloves, face shield, or other appropriate protective clothing to prevent skin contact with liquid acrylonitrile. Replace or repair impervious clothing that has developed leaks. Where protective clothing is required, your employer is required to provide clean garments to you weekly.

Acrylonitrile should never be allowed to remain on the skin. Clothing and shoes should not be allowed to become contaminated with acrylonitrile, and if they do, the clothing should be promptly removed and laundered or discarded, and the shoes should be discarded. Once acrylonitrile penetrates shoe leather, or other leather articles, the article should not be worn again.

D. Eye Protection: You must wear splashproof safety goggles in areas where liquid acrylonitrile may contact your eyes. In addition, contact lenses should not be worn in areas where eye contact with acrylonitrile can occur.

### V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

A. Acrylonitrile is a flammable liquid and its vapors can easily form explosive mixtures in air.

B. Acrylonitrile must be stored in tightly-closed containers in a cool, well-ventilated area, away from heat, sparks, flames, strong

oxidizers (especially bromine), strong bases, copper, copper alloys, ammonia, and amines.

C. Sources of ignition such as smoking and open flames are prohibited wherever acrylonitrile is handled, used, or stored in a manner that could create a potential fire or explosion hazard.

D. You should use non-sparking tools when opening or closing metal containers of acrylonitrile, and containers must be bonded and grounded when pouring or transferring liquid acrylonitrile.

E. You must immediately remove any non-impervious clothing that becomes contaminated with acrylonitrile, and this clothing must not be reworn until the acrylonitrile is removed from the clothing.

F. Clothing wet with liquid acrylonitrile can be easily ignited. You must promptly remove this clothing, and it must not be reworn until the acrylonitrile is removed from the clothing.

G. If your skin becomes wet with liquid acrylonitrile, you must promptly and thoroughly wash or shower with soap or mild detergent to remove any acrylonitrile from your skin.

H. You must not keep food, beverages, or smoking materials in areas where acrylonitrile is handled, processed, or stored, nor are you permitted to eat or smoke in these areas.

I. If you handle acrylonitrile, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

J. Fire extinguishers and quick drenching facilities must be readily available, and you should know where they are and how to operate them.

K. Ask your supervisor where acrylonitrile is used in your work area and for any additional plant safety and health rules.

### VI. ACCESS TO INFORMATION

A. Each year, your employer is required to inform you of the information contained in this Substance Safety Data Sheet for acrylonitrile. In addition, your employer must instruct you in the proper work-practices for using acrylonitrile, emergency procedures, and the correct use of protective equipment.

B. Your employer is required to determine whether you are being exposed to acrylonitrile. You or your representative has the right to observe employee exposure measurements and to record the results obtained. Your employer is required to inform you of your exposure. If your employer determines that you are being overexposed, he or she is required to inform you of the actions which are being taken to reduce your exposure to within permissible exposure limits.

C. Your employer is required to keep records of your exposures and medical examinations. These records must be kept by the employer for at least the effective period of this emergency temporary standard.

D. Your employer is required to release exposure and medical records to your physician upon your written request.

## APPENDIX B.—SUBSTANCE TECHNICAL GUIDELINES FOR ACRYLONITRILE

### I. PHYSICAL AND CHEMICAL DATA

A. Substance identification:

1. Synonyms: AN; VCN; Vinyl Cyanide; Propenenitrile; Cyanoethylene; Acrylon; Carbacryl; Fumigrain; Ventox.

2. Formula: $CH_2=CHCN$.

3. Molecular Weight: 53.1.

B. Physical Data:

1. Boiling Point (760 mm Hg): 77.3° C (171° F).

2. Specific Gravity (water=1): 0.81 (at 20° C or 68° F).

3. Vapor Density (air=1 at boiling point of acrylonitrile): 1.83.

4. Melting Point: −83° F (−117° F).

5. Vapor Pressure at 20° C (68° F): 83 mm Hg.

6. Solubility in Water. Percent by weight at 20° C (68° F): 7.35.

7. Evaporation Rate (Butyl Acetate=1): 4.54.

8. Appearance and Odor: Colorless to pale yellow liquid with a pungent odor at concentrations above the permissible exposure level. Any detectable odor of acrylonitrile may indicate overexposure.

### II. FIRE, EXPLOSION, AND REACTIVITY HAZARD DATA

A. Fire:

1. Flash Point: −1° C (30° F) (open cup).

2. Autoignition Temperature: 481° C (898° F).

3. Flammable limits in air, Percent by volume: Lower: 3; Upper: 17.

4. Extinguishing media: Alcohol foam, carbon dioxide, dry chemical.

5. Special fire-fighting procedures: Do not use a solid stream of water, since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.

6. Unusual fire and explosion hazards: Acrylonitrile is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where acrylonitrile is handled, used, or stored in a manner that could create a potential fire or explosion hazard. Acrylonitrile vapors are heavier than air and may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which acrylonitrile is being handled.

7. For purposes of compliance with the requirements of 29 CFR 1910.106, acrylonitrile is classified as a Class IB flammable liquid. For example, 7500 ppm, approximately one-fourth of the lower flammable limit, would be considered to pose a potential fire and explosion hazard.

8. For purposes of compliance with 29 CFR 1910.157, acrylonitrile is classified as a Class B fire hazard.

9. For purposes of compliance with 29 CFR 1910.309, locations classified as hazardous due to the presence of acrylonitrile shall be Class I Group D.

B. Reactivity.

1. Conditions contributing to instability: Acrylonitrile will polymerize when hot, and the additional heat liberated by the polymerization may cause containers to explode. Pure AN may self-polymerize with a rapid build-up of pressure resulting in an explosion hazard. Inhibitors are added to the commercial product to prevent self-polymerization.

2. Incompatibilities: Contact with strong oxidizers (especially bromine) and strong bases may cause fires and explosions. Contact with copper, copper alloys, amnonia, and amines may start serious decomposition.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen cyanide, oxides of nitrogen, and carbon monoxide) may be released in a fire involving acrylonitrile and certain polymers made from acrylonitrile.

4. Special precautions: Liquid acrylonitrile will attack some forms of plastics, rubbers, and coatings. Acrylonitrile monomer should be checked at least weekly to determine inhibitor content.

### III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If acrylonitrile is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. The area should be evacuated at once and re-entered only after thorough ventilation.

3. If liquid acrylonitrile, collect for reclamation or absorb in paper, vermiculite, dry sand, earth, or similar material.

4. If acrylonitrile polymer, collect spilled material in the most convenient and safe manner for reclamation or for disposal.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until clean-up has been completed.

C. Waste disposal methods: Waste material shall be disposed of in a manner that is not hazardous to employees or to the general population. Spills of acrylonitrile and flushing of such spills shall be channeled for appropriate treatment or collection for disposal. They shall not be channeled directly into the sanitary sewer system. Containers of AN and PAN wastes shall be appropriately labelled. In selecting the method of waste disposal, applicable local, state, and federal regulations should be consulted.

### IV. MONITORING AND MEASUREMENT PROCEDURES

A. Exposure above the Permissible Exposure Limit:

1. Eight-hour exposure evaluation: Measurements taken for the purpose of determining employee exposure under this section are best taken so that the average eight-hour exposure may be determined from a single 8-hour sample or two (2) 4-hour samples. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

2. Ceiling evaluation: Measurements taken for the purpose of determining employee exposure under this section must be taken during periods of maximum expected airborne concentrations of acrylonitrile in the employee's breathing zone. A minimum of three (3) measurements should be taken on one work shift. The highest of all measurement taken is an estimate of the employee's ceiling exposure.

3. Monitoring techniques: The sampling and analysis under this section may be performed by collecting the acrylonitrile vapor on charcoal adsorption tubes or other composition adsorption tubes, with subsequent chemical analysis. Sampling and analysis may also be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, or passive dosimeters, as well as by gas and vapor adsorption tubes. The method of measurement chosen should determine the airborne levels of acrylonitrile to an accuracy of plus or minus 25 percent for concentrations of AN at or above the permissible exposure limit, and to within plus or minus 35 percent for concentrations between the action level and the permissible exposure limits.

4. Survey of operations. OSHA suggests that the employer use a direct-reading instrument, such as a portable infra-red ana-

lyzer, or equivalent points-monitoring system, to survey weekly, all operations involving liquid AN to determine points at which AN vapor or liquid may be released into the workplace. A listing of points monitored, together with levels of acrylonitrile detected, if any, shall be prepared from this survey, and the listing shall be displayed prominently in the workplace. As an alternative survey method, grab samples, utilizing vapor collection bags, with subsequent gas chromatographic analysis, can be used for this survey.

B. Since many of the duties relating to employee exposure are dependent on the results of monitoring and measuring procedures, employers shall assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

#### V. PROTECTIVE CLOTHING

Employees shall be provided with, and required to wear appropriate protective clothing to prevent any possibility of skin contact with liquid AN or PAN. Because acrylonitrile is absorbed through the skin, it is important to prevent skin contact with the liquid. Protective clothing shall include impermeable coveralls or similar full-body work clothing, gloves, head-coverings, and workshoes or shoe coverings, as appropriate to protect areas of the body which may come in contact liquid AN or PAN.

Employers should ascertain that the protective garments are impermeable to acrylonitrile. Non-impermeable clothing and shoes should not be allowed to become contaminated with acrylonitrile. If permeable clothing does become contaminated, it should be promptly removed and not worn again until completely free of the material. If leather footwear or other leather garments become wet from acrylonitrile, they should be replaced and not worn again, due to the ability of leather to absorb acrylonitrile and hold it against the skin. Since there is no pain associated with the blistering, it is essential that the employee be informed of this hazard so that he or she can be protected.

Any protective clothing which has developed leaks or is otherwise found to be defective should be repaired or replaced. Clean protective clothing shall be provided weekly to the employee, and whenever the clothing becomes wet with liquid AN or PAN. Employees are also required to wear splashproof safety goggles where there is any possibility of acrylonitrile contacting the eyes.

#### VI. HOUSEKEEPING AND HYGIENE FACILITIES

For purposes of complying with 29 CFR 1910.141, the following items should be emphasized:

A. The workplace should be kept clean, orderly, and in a sanitary condition;

B. Dry sweeping and the use of compressed air is unsafe for the cleaning of floors and other surfaces where liquid AN or PAN may be found;

C. Adequate washing facilities with hot and cold water should be provided, and maintained in a sanitary condition. Suitable cleansing agents should also be provided to assure the effective removal of acrylonitrile from the skin;

D. Change or dressing rooms with individual clothes-storage facilities should be provided to prevent the contamination of street clothes with acrylonitrile. Because of the hazardous nature of acrylonitrile, contaminated protective clothing should be stored in closed containers for cleaning or disposal.

#### VII. MISCELLANEOUS PRECAUTIONS

A. Store acrylonitrile in tightly-closed containers in a cool, well-ventilated area, and take the necessary precautions to avoid an explosion hazard.

B. High exposure to acrylonitrile can occur when transferring the liquid from one container to another.

C. Non-sparking tools must be used to open and close metal acrylonitrile containers. These containers must be effectively grounded and bonded prior to pouring.

D. Never store uninhibited acrylonitrile. The inhibitor content shall be determined weekly.

E. Acrylonitrile vapors are not inhibited. They may form polymers and clog vents of storage tanks.

F. Use of supplied-air suits or other impervious coverings may be necessary to prevent skin contact and provide respiratory protection from with acrylonitrile where the concentration of acrylonitrile is unknown or is above the ceiling limit. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life-endangering characteristics of supplied-air suits.

G. Employers shall advise employees of all areas and operations where exposure to acrylonitrile could occur.

#### VIII. COMMON OPERATIONS

Common operations in which exposure to acrylonitrile is likely to occur include the following: manufacture of the acrylonitrile monomer; synthesis of acrylic fibers, ABS and SAN plastics, resins, nitrile rubber, surface coatings, specialty chemicals, use as a chemical intermediate, use as a fumigant and in the cyanoethylation of cotton.

### APPENDIX C—MEDICAL SURVEILLANCE GUIDELINES FOR ACRYLONITRILE

#### I. ROUTE OF ENTRY

Inhalation; skin and absorption; ingestion.

#### II. TOXICOLOGY

Acrylonitrile vapor is an asphyxiant due to its inhibitory action on metabolic enzyme systems. Animals exposed to 75 or 100 ppm for 7 hours have shown signs of anoxia; in some animals which died at the higher level, cyanomethemoglobin was found in the blood. Two human fatalities from accidental poisoning have been reported; one was caused by inhalation of an unknown concentration of the vapor, and the other was thought to be caused by skin absorption or inhalation. Most cases of intoxication from industrial exposure have been mild, with rapid onset of eye irritation, headache, sneezing, and nausea. Weakness, lightheadedness, and vomiting may also occur. Exposure to high concentrations may produce profound weakness, asphyxia, and death. The vapor is a severe eye irritant. Prolonged skin contact with the liquid may result in absorption with systemic effects, and in the formation of large blisters after a latent period of several hours. Although there is usually little or no pain or inflammation, the affected skin resembles a second-degree thermal burn. Solutions spilled on exposed skin, or on areas covered only by a light layer of clothing, evaporate rapidly, leaving no irritation, or, at the most, mild transient redness. Repeated spills on exposed skin may result in dermatitis due to solvent effects.

Results after one year of a planned two-year animal study on the effects of exposure to acrylonitrile have indicated that rats ingesting as little as 35 ppm in their drinking water develop tumors of the central nervous system. The interim results of this study have been supported by a similar study being conducted by the same laboratory, involving exposure of rats by inhalation of acrylonitrile vapor, which has shown similar types of tumors in animals exposed to 80 ppm.

In addition, the preliminary results of an epidemiological study being performed by duPont on a cohort of workers in their Camden, South Carolina acrylic fiber plant indicate a statistically significant increase in the incidence of colon and lung cancer among employees exposed to acrylonitrile.

#### III. SIGNS AND SYMPTOMS OF ACUTE OVEREXPOSURE

Asphyxia and death can occur from exposure to high concentrations of acrylonitrile. Symptoms of overexposure include eye irritation, headache, sneezing, nausea and vomiting, weakness, and light-headedness. Prolonged skin contact can cause blisters on the skin, with the appearance of a second degree thermal burn, but with little or no pain. Repeated skin contact may produce scaling dermatitis.

#### IV. TREATMENT OF ACUTE OVEREXPOSURE

Remove employee from exposure. Immediately flush eyes with water and wash skin with soap or mild detergent and water. If AN has been swallowed and person is conscious, induce vomiting. Give artificial resuscitation if indicated. More severe cases, such as those associated with loss of consciousness, may be treated by the intravenous administration of sodium nitrite, followed by sodium thiosulfate, although this is not as effective for acrylonitrile poisoning as for inorganic cyanide poisoning.

#### V. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. As noted above, exposure to acrylonitrile has been linked to increase incidence of cancers of the colon and lung in employees of the duPont acrylic fiber plant in Camden, S.C. In addition, the animal testing of acrylonitrile has resulted in the development of cancers of the central nervous system in rats exposed by either inhalation or ingestion. The physician should be aware of the findings of these studies in evaluating the health of employees exposed to acrylonitrile.

Most reported acute effects of occupational exposure to acrylonitrile are due to its ability to cause tissue anoxia and asphyxia. The effects are similar to those caused by hydrogen cyanide. Liquid acrylonitrile can be absorbed through the skin upon prolonged contact. The liquid readily penetrated leather, and will produce burns of the feet if footwear contaminated with acrylonitrile is not removed.

It is important for the physician to become familiar with the operating conditions in which exposure to acrylonitrile may occur. Those employees with skin diseases may not tolerate the wearing of whatever protective clothing may be necessary to protect them from exposure. In addition, those with chronic respiratory disease may not tolerate the wearing of negative-pressure respirators.

B. Surveillance and screening. Medical histories and laboratory examinations are required for each employee subject to exposure to acrylonitrile above the action level.

The employer must screen employees for history of certain medical conditions which might place the employee at increased risk from exposure.

1. *Central nervous system dysfunction.* Acute effects of exposure to acrylonitrile generally involve the central nervous system. Symptoms of acrylonitrile exposure include headache, nausea, dizziness, and general weakness. The animal studies cited above suggest possible carcinogenic effects of acrylonitrile on the central nervous system, since rats exposed by either inhalation or ingestion have developed similar CNS tumors.

2. *Respiratory disease.* The duPont data indicate an increased risk of lung cancer among employees exposed to acrylonitrile.

3. *Gastrointestinal disease.* The duPont data indicate an increased risk of cancer of the colon among employees exposed to acrylonitrile. In addition, the animal studies show possible tumorogenic effects on the stomachs of the rats in the ingestion study.

4. *Skin disease.* Acrylonitrile can cause skin burns when prolonged skin contact with the liquid occurs. In addition, repeated skin contact with the liquid can cause dermatitis.

5. *General.* The purpose of the medical procedures outlined in the standard is to establish a baseline for future health monitoring. Persons unusually susceptible to the effects of anoxia or those with anemia would be expected to be at increased risk. In addition to emphasis on the CNS, respiratory and gastrointestinal systems, the cardiovascular system, liver and kidney function should also be stressed.

APPENDIX REFERENCES

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(Secs. 4, 6, 8, 84 Stat. 1593, 1599 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 8-76 (41 FR 25059); 29 CFR Part 1911).)

[FR Doc. 78-1274 Filed 1-16-78; 11:00 am]

[4510-26]

## DEPARTMENT OF LABOR

**Occupational Safety and Health Administration**

**[29 CFR Part 1910]**

[Docket No. H-108]

### OCCUPATIONAL EXPOSURE TO ACRYLONITRILE (VINYL CYANIDE)

**Proposed Standard and Notice of Hearing**

AGENCY: Occupational Safety and Health Administration (OSHA), Department of Labor

ACTION: Proposed rule and notice of hearing.

SUMMARY: The Occupational Safety and Health Administration (OSHA), in today's issue of the FEDERAL REGISTER at page —, published an Emergency Temporary Standard (ETS) regulating employee exposure to acrylonitrile (AN) (vinyl cyanide). The basis for the ETS was a determination by the Assistant Secretary, based on animal and human epidemiological data, that exposure to acrylonitrile constitutes a cancer hazard. By this notice, OSHA proposes a permanent standard for the regulation of acrylonitrile. The proposal contains three alternative sets of permissible exposure limits which are among those being considered by OSHA for the permanent standard: 2 parts AN per million parts of air (2 ppm) as an eight (8)-hour time-weighted average (TWA), with a 10 ppm ceiling limit over any 15 minute period during the workshift; 1 ppm TWA with a 5 ppm ceiling; and 0.2 ppm TWA with a 1 ppm ceiling. In addition, the proposal would prohibit eye and skin exposure. An "action level" equal to an eight (8)-hour TWA of one-half the permissible exposure limit, is included in the proposal. The proposed standard contains several conditions upon which operations involving the fabrication of products from polyacrylonitrile (PAN) may be exempted from coverage. The proposal requires, among other things, certain methods of compliance, personal protective equipment, measurement of employee exposures, training, work practices, medical surveillance, signs, labels, and recordkeeping. A permanent standard will supersede the existing ETS at the conclusion of the rulemaking.

DATES: Comments concerning the proposed permanent standard must be postmarked on or before February 21, 1978. Notices of intention to appear at the informal rulemaking hearing must be postmarked on or before February 27, 1978. Parties requesting more than 15 minutes for their presentations at the hearing, and parties submitting documentary evidence at the hearing must submit the full text of their testimony and all documentary evidence no later than March 7, 1978. An informal public rulemaking hearing is scheduled to begin March 21, 1978.

FOR FURTHER INFORMATION CONTACT:

Ms. Gail Kleiner, Office of Carcinogen Standards, OSHA, Third Street and Constitution Avenue NW., Room N-3654, Washington, D.C. 20210, telephone 202-523-9603.

SUPPLEMENTARY INFORMATION:

#### I. BACKGROUND

In today's issue of the FEDERAL REGISTER, OSHA has published an Emergency Temporary Standard (ETS) regulating exposure to acrylonitrile (AN) in the workplace (29 CFR 1910.1045). The ETS, and the preamble explaining the reasons therefor, are incorporated herein in their entirety. Pursuant to sections 6(b), 6(c), and 8(c) of the Occupational Safety and Health Act of 1970 (the Act) (84 Stat. 1593, 1596, 1599; 29 U.S.C. 655, 657), the Secretary of Labor's Order No. 8-76 (41 FR 25059), and 29 CFR Part 1911, it is hereby proposed to amend Part 1910 of 29 CFR by revising 29 CFR 1910.1045 (43 FR —).

This proposed permanent standard applies to all employments in all industries covered by the Act, namely "general industry," construction and maritime.

OSHA seeks public comments, information, and evidence on all issues raised in the ETS and the proposal, including the following:

1. Whether the proposed provisions would provide adequate worker protection from all health hazards associated with AN exposure.

2. Whether .2 ppm TWA and 1 ppm ceiling are sufficiently low to adequately protect employees; whether 1 ppm TWA and 5 ppm ceiling will adequately protect employees; whether 2 ppm TWA and 10 ppm ceiling will adequately protect employees; and whether PEL's other than those expressly proposed would adequately protect employees.

3. Whether compliance with a .2 ppm TWA and 1 ppm ceiling is feasible for all affected industries; whether compliance with a 1 ppm TWA and 5 ppm ceiling is feasible for all affected industries; and whether compliance with 2 ppm TWA and 10 ppm ceiling is feasible for all affected industries.

4. Whether eye and skin contact with AN should be prohibited.

5. Whether a weekly survey of operations involving liquid AN to determine points of AN release is appropriate for the standard, and what types of equipment are available for such a survey.

6. Whether the provisions for recordkeeping, methods of compliance, medical surveillance, regulated areas, personal protective equipment, protective clothing, hygiene facilities and practices are appropriate and feasible.

7. Whether medical removal protection should be provided where, as a result of the medical surveillance program, it is determined that an employee is at an increased risk of material impairment of health from further exposure to AN.

8. Whether the provisions for training, posting and labeling are appropriate and fully apprise employees of the hazards of AN exposure.

9. Whether levels of residual AN can adequately be correlated with employee exposures; and whether quantities of residual AN can feasibly be reduced in acrylonitrile-based polymers and polymer products as a means of controlling employee exposures.

10. Whether the proposed action has any significant adverse environmental impact.

11. What is the economic impact of the proposed actions?

12. What methods are available for monitoring and determining employee exposures to AN, including passive dosimeters, and what are their sensitivities, accuracies, and possible interference?

In the development of this proposal, OSHA has received recommendations and data from the National Institute for Occupational Safety and Health, as well as numerous reference works, studies, case histories, and journal articles, some of which are included in the reference section of the ETS. The discussions in the ETS which conclude that acrylonitrile poses a cancer hazard to humans will not be repeated here.

#### II. PERTINENT LEGAL AUTHORITY

The primary purpose of the Act is to assure, so far as possible, safe and healthful working conditions for every working man and woman. One means prescribed by Congress to achieve this goal is the authority vested in the Secretary of Labor to set mandatory safety and health standards.

Occupational safety and health standards provide notice of the requisite conduct or exposure level and provide a basis for assuring the existence of safe and healthful workplaces. The act provides that:

> The Secretary, in promulgating standards dealing with toxic materials or harmful physical agents under this subsection, shall set the standard which most adequately assures, to the extent feasible, on the basis of the best available evidence, that no employee will suffer material impairment of health or functional capacity even if such employee has regular exposure to the hazard dealt with by such a standard for the period of his working life. Development of standards under this subsection shall be based upon research, demonstrations, experiments, and such other information as may be appropriate. In addition to the attainment of the highest degree of health and safety protection for the employee, other considerations

shall be the latest available scientific data in the field, the feasibility of the standards, and experience gained under this and other health and safety laws. (Section 6(b)(5).)

Sections 2(b) (5) and (6), 20, 21, and 24 of the Act reflect Congress' recognition that conclusive medical or scientific evidence, including causative factors, epidemiological studies or dose-response data, may not exist for many toxic materials or harmful physical agents. Nevertheless, standards cannot be postponed because definitive medical or scientific evidence is not currently available. Indeed, standards need only be supported by the best available evidence. The legislative history makes it clear that "it is not intended that the Secretary be paralyzed by debate surrounding diverse medical opinion." House Committee on Education and Labor, Report No. 91-1291, 91st Cong., 2d Session, p. 18 (1970). This Congressional judgment is supported by the courts which have reviewed standards promulgated under the Act. In sustaining the standard for occupational exposure to vinyl chloride (29 CFR 1910.1017), the U.S. Court of Appeals for the Second Circuit stated that "it remains the duty of the Secretary to act to protect the working man, and to act even in circumstances where existing methodology or research is deficient." *Society of the Plastics Industry, Inc.* v. *Occupational Safety and Health Administration,* 509 F. 2d 1301 (2d Cir., 1975), cert. denied, 421 U.S. 992 (1975).

A similar rationale was applied by the U.S. Court of Appeals for the District of Columbia Circuit in reviewing the standard for occupational exposure to asbestos (29 CFR 1910.1001). The Court stated that:

> Some of the questions involved in the promulgation of these standards are on the frontiers of scientific knowledge, and consequently as to them insufficient data is presently available to make a fully informed factual determination. Decision-making must in that circumstance depend to a greater extend upon policy judgments and less upon purely factual judgments.

*Industrial Union Department, AFL-CIO* v. *Hodgson,* 499 F. 2d 467, 474 (C.A.D.C. 1974).

In setting standards, the Secretary is expressly required to consider the feasibility of the proposed standards. Senate Committee on Labor and Public Welfare, S. Rept. No. 91-1282, 91st Cong., 2d Sess., p. 58 (1970). Nevertheless, considerations of technological feasibility are not limited to devices already developed and in use. Standards may require improvements in existing technologies or require the development of new technology. *Society of the Plastics Industry, Inc.* v. *Occupational Safety and Health Administration, supra,* at 1309.

Where appropriate, the standards are required to include provisions for labels or other forms of warning to apprise employees of hazards, suitable protective equipment, control procedures, monitoring and measuring of employee exposure, employee access to the results of monitoring, and appropriate medical examinations. Moreover, where a standard prescribes medical examinations or other tests, they must be made available at no cost to the employees (section 6(b)(7)). Standards may also prescribe recordkeeping requirements where necessary or appropriate for enforcement of the Act or for developing information regarding occupational accidents and illnesses (Section 8(c)).

## III. Summary and Explanation of Additions to or Modifications of the ETS

The requirements imposed by OSHA in the ETS are those requirements which OSHA considers to be essential and feasible to meet immediately, pending the development of a permanent standard. The preamble to the ETS explains the purpose and rationale for the provisions of the ETS. The following sections discuss provisions of the proposal which differ significantly from the ETS and which OSHA believes are more appropriate for a permanent regulation of employee exposure to acrylonitrile.

1. *Paragraph (a).—Scope and application.* The proposal, as does the ETS, includes conditions upon which an employer involved in the processing, use, or handling of materials made from polyacrylonitrile (PAN) can obtain exemption from the provisions of the standard. However, because the proposal contains several alternative sets of permissible exposure limits, as will be discussed below, the conditions for exemption in the proposal must be changed to reflect the various alternatives under consideration. The changes that are made in the exemptions as proposed are intended to assure that employees engaged in processing operations will not be exposed above the action level which applies for each alternative set of permissible exposure limits.

The first condition for exemption under the ETS applies if an employer can provide, and establish that he reasonably relied upon, objective data to demonstrate that the material to be processed is incapable of releasing AN resulting in air concentrations above 1 ppm under the expected conditions of use which will cause the greatest release. In the proposal, the level for exemption is maintained at one-half the permissible TWA exposure limit. Thus, for a permissible exposure limit of 2 ppm, materials which are incapable of releasing AN above 1 ppm would be exempted; for a permissible exposure limit of 1 ppm, the exemption level would be 0.5 ppm; and for a permissible exposure limit of 0.2 ppm, the exemption level would be 0.1 ppm. This should not be confused with the action level concept, which refers to employee exposures rather than to the capability of release above certain levels.

In addition to the two conditions for exemptions contained in the ETS, OSHA is proposing a third condition for exemption from the provisions of the permanent standard, based upon residual AN content of products fabricated from polyacrylonitrile (PAN). Except for latexes and other liquid mixtures, where the material to be processed contains less than a specified amount of residual AN by weight, the processing, handling, and use of that material would be exempted from the standard. At the present time, the proposal does not include a particular level which would qualify for the exemption. The reasons for this action are threefold. First, there is presently no data in the record upon which OSHA can reliably make any definite correlation between residual levels and resulting airborne concentrations of AN during processing. Second, OSHA notes with interest that manufacturers are presently developing more efficient methods for stripping residual monomer from their polymers. The Agency anticipates the receipt of information during the course of this rulemaking as to the techniques employed and the progress being made in improving them. As noted in the ETS, the lower the residual AN levels in PAN the lower the potential for AN exposures to employees working with the PAN in processing operations. Third, the alternative sets of permissible exposure limits in the proposal, together with their respective action levels, provide upper bounds against which any conditions for exemption from the standard must be evaluated. In brief, the lower the exposure limit being considered, the more limited will be the exemption in order to assure that employees who are exempted are not, in fact, being exposed above the action level. Because of the range of exposure limits under consideration, OSHA believes that it is prudent not to propose a specific upper bound for residual AN at this time, but that such a determination should await the submission of comments and data on residual AN levels in various PAN materials, the effectiveness of existing and prospective stripping methods, and correlations between residual AN levels and resulting air concentrations of AN various during processing operations.

The third condition for exemption in the proposal, which concerns PAN materials which are not heated or melted, is unchanged from the ETS. OSHA believes that the processing of PAN (except for latexes and other liquid mixtures) without heating or melting does not present a significant

AN exposure potential to employees.

OSHA welcomes data and information on residual AN levels in AN-based polymers and products, and their relationship to airborne concentrations of AN which may be released during operations where such polymers and products are processed. OSHA also requests data and information on the technology involved in the removal of residual monomer from PAN, and the methods used in determining the amounts of AN remaining in the polymer both before and after stripping.

In exempting operations based upon the residual AN content of materials being processed, OSHA is considering a provision which would lower the maximum allowable residual content by incremental steps during the first year or two years after the final standard becomes effective. As previously noted, the appropriate residual levels have not yet been determined, but will depend upon data and information received in the course of the rulemaking proceedings. Lowering levels of residual AN for the exemption incrementally would allow companies sufficient lead time to develop the methods necessary to reduce the residual monomer content of their products. OSHA invites comments on the steps necessary for reduction of residual AN, the amount of time believed to be necessary to develop the appropriate technology, and the appropriateness of such a phasing-in of a lower residual AN level for the purposes of determining exemptions from the standard.

2. *Paragraph (b).—Definitions.* The definition of "action level" is revised from the ETS to reflect the proposed changes in the permissible exposure limits. Three alternative action levels are provided in order to correspond to the alternative sets of permissible exposure limits as proposed. The proposed action levels are defined as eight (8)-hour time-weighted average concentrations of one-half of the respective permissible exposure limits. The rationale for the action level, the effects of including it in the standard, and the ways in which it reduces the burden of compliance for many employers are all discussed in the preamble to the ETS.

A definition of the term "emergency" is added to the proposed permanent standard. For the purposes of the standard, emergencies are occurrences such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which are likely to, or do, result in unexpected exposure to acrylonitrile or to AN vapor in excess of the ceiling limit.

3. *Paragraph (c).—Permissible exposure limits (PEL).* The permissible exposure limits set forth in the proposal are more stringent than those in the ETS. The proposal provides three alternative sets of permissible exposure limits for consideration; 2 ppm as an eight (8)-hour time-weighted average (TWA), with a ceiling limit of 10 ppm measured over any 15-minute period during the workshift (2/10 proposal); 1 ppm TWA with a 5 ppm ceiling (1/5 proposal); and 0.2 ppm TWA with a 1 ppm ceiling (0.2/1 proposal). The 2/10 proposal is clearly more stringent than the ETS, which also has exposure limits of 2/10, because of the greater flexibility available under the ETS as to methods of compliance, as discussed below.

The 2/10 exposure limits in the ETS are based upon the data currently in the record, which indicate, as noted in the ETS preamble, that these are the lowest levels attainable during the limited timeframe of the emergency standard. For the purposes of the final rule, however, OSHA believes that it is appropriate to look more closely at the development of improved technology. Standards may require improvements in existing technologies or require the development of new technology. *The Society of the Plastics Industry* v. *OSHA, supra,* at 1309. In the present situation, where efforts are already underway to improve esisting methods of controlling employee exposures to AN, the proposal anticipates the continuation of such efforts and their expansion under the permanent standard. It is in this context that OSHA is considering lowering the permissible exposure limits.

By including several sets of alternative permissible exposure limits in the proposal, OSHA acknowledges that there is much data and information yet to be gathered as to what constitutes the lowest feasible level of exposure to AN in the affected industries. It should be noted that although OSHA has expressly proposed three alternative sets of permissible exposure limits, the PEL in the final rule will be the lowest feasible levels, based upon the entire record of the proceeding, and may differ from the proposed levels.

As noted in the proposed OSHA Cancer Policy, exposures to a carcinogen should be reduced to the lowest levels feasible, since there is as yet no satisfactory scientific basis for determining a no-effect or threshold level for a carcinogen for any given population (42 FR 54148, at 54174).

OSHA welcomes any and all data available as to the appropriate permissible exposure limits for AN, the feasibility of the proposed exposure limits and any other exposure limits which should be considered by OSHA, as well as other related issues.

In making a preliminary determination as to the feasibility of the proposed standard for AN, OSHA has taken note of the proven ability of the chemical and plastics industries to develop the necessary controls and other techniques for compliance with the standard on vinyl chloride (VC) exposure (29 CFR 1910.1017). There are many similarities between VC and AN, ranging from their chemical structure through their methods of processing to the final products fabricated from them. Both are monomers, and as such, they are prized for their abilities to form useful and durable polymers, such as PVC and ABS resins, respectively.

The technology needed for the "stripping" of VC monomer from PVC resins was developed by the VC and PVC manufacturers in response to the requirements in the OSHA standards. It is anticipated that similar technological development will be necessary in some cases to achieve the same degree of reduction of AN monomer levels in AN-based resins, latexes, and other polymers. Similarly, new methods of reduction of airborne VC levels in manufacturing and polymerization operations have been forthcoming in the past several years, as have new and more sophisticated techniques of measuring those levels in the workplace. It may well become necessary for these types of innovations to be developed with regard to AN, as well, in the future.

OSHA has noted the capability of the chemical and plastics industries to adapt their operations and make necessary changes to reduce employee exposures to toxic substances and carcinogens. Many of the breakthroughs and improvements brought about in the context of vinyl chloride are relevant to the control of employee exposures to acrylonitrile. Where there are areas in which the control of VC and AN differ, OSHA is confident that the affected companies will continue to demonstrate their innovative abilities to meet the challenge. With regard to vinyl chloride, industry has shown that many problems which were formerly looked upon as unsolvable have now been solved satisfactorily. Although it cannot be said that the control of AN exposures in the workplace will be a simple matter, OSHA is confident that, based upon recent performance by the affected industries, it can be accomplished.

4. *Paragraph (e).—Exposure monitoring. Weekly survey of operations involving liquid AN.* OSHA recognizes that the use of instruments to detect the presence of AN at levels below the permissible exposure limits can be of great benefit in determining potential sources of employee exposure. In addition, it may also assist in pinpointing trouble spots, such as leaks and defective seals, before they become more serious problems. The data submitted into the record to date indicate that there are several methods available, such as the use of infra-red gas analyzers and multi-point sequential sam-

pling systems, which are capable of detecting AN at levels in the range of 0.2 to 0.4 ppm or below. Although there is clearly a difference between detecting AN and measuring employee exposures to AN, OSHA believes that a system for the early detection of fugitive emissions of AN can be of great value in controlling emissions and limiting potential exposures. Therefore, a weekly survey of operations involving liquid AN has been included in the proposed permanent standard.

OSHA has determined that a weekly survey would be of greatest value in operations where the monomer is produced, used, or processed, since it is in such operations that a leak or spill is most likely to occur and to cause the greatest potential for employee exposure to AN above the permissible exposure limits. The proposal would require the employer to survey, on a weekly basis, using an infra-red detector or similar AN detection system, areas of operations where liquid AN is manufactured, used, or processed.

The weekly survey requirement is flexible as to the type of equipment required for measurement of levels of AN. Employers are permitted to use such methods as detector tubes, Saran bag "grab samples", and portable infra-red gas analyzers. In addition, OSHA has learned that several companies either have installed, or are presently in the process of installing, fixed point area monitoring systems with sequential sampling, similar to those developed for detecting vinyl chloride. Such systems would be ideal for developing the kind of data to be obtained from the weekly survey, and are encouraged, but not specifically required, by the proposal. The reasons for flexibility as to the methods used in the weekly survey are twofold. First, OSHA emphasizes that the personal monitoring required by the proposal is the primary method of determining employee exposures. Detailed requirements are included in the standard as to the required precision and accuracy of the methods for determining employee exposure. The weekly survey, on the other hand, is a means of detecting AN levels before they become significant parts of an employee's exposure.

Second, the weekly survey should not be overly time-consuming. By allowing the employer the widest latitude in selecting a method that is most efficient for his/her operations, the provision most adequately assures that the survey will be carried out as required.

5. *Paragraph (f).—Regulated areas.* Where AN concentrations are in excess of permissible exposure limits, the employer must establish a regulated area. The purpose of establishing regulated areas is to limit AN exposure to as few employees as possible. The burden on the employer is expected to be minimal, since the provisions of the proposed permanent standard require the employer merely to identify and control access to regulated areas and to notify the applicable OSHA Area Office of their existence and the conditions therein.

6. *Paragraph (g).—Methods of Compliance.* The proposed standard would require the employer to institute engineering and work practice controls to reduce employee exposures to or below the permissible limits. In situations where engineeting and work practice controls that can be instituted immediately will not reduce exposures to the permissible exposure limits, these controls must nonetheless be used to reduce exposures to the lowest feasible level and be supplemented by the use of respirators. In addition, a compliance program to reduce exposures to within the permissible exposure limits solely by means of engineering and work practice controls must be developed and implemented. Written plans for this program must be developed and be furnished upon request for examination and copying to representatives of the Assistant Secretary, representatives of the Director, or affected employees. These plans must be reviewed and updated periodically to reflect the current status of the program.

Engineering controls are the preferred means of compliance because they reduce exposure hazards in the workplace environment by removing the airborne contaminant. Engineering controls may include the installation of local exhaust ventilation, modification of a process so as to reduce emission of the contaminant into the workplace, or substitution of another substance for acrylonitrile. Work practices are often necessary for the effective operation of engineering controls, and they are also a preferred means of controlling exposures.

Respirators are the least satisfactory means of control because of certain difficulties inherent in their use. Respirators are capable of providing good protection only if they are properly selected for the concentrations of airborne contaminants present, properly fitted to the employee, properly worn by the employee, and replaced when they have ceased to provide protection. While it is theoretically possible for all of these conditions to be met, it is more often the case that they are not. As a consequence, the protection of employees by respirators is not always effective.

OSHA recognizes that there are certain activities, often involving certain maintenance operations, in which the use of engineering controls to control exposures will not be feasible, regardless of the permissible exposure limits in the standard. Where the employer can show that the engineering control of such operations is not feasible, respirators shall be permitted as a primary means of control of AN exposures.

7. *Paragraph (h)—Respiratory protection.* The provisions for respirator protection in the proposal differ from those of the ETS in three ways. First, the limits for the appropriate use of the various respirators, as specfied in Table I, are adjusted to reflect the alternative permissible exposure limits as provided in the proposal. The conditions of AN exposure and respirator usage are expressed in the proposal as multiples of the permissible exposure limits instead of in terms of ppm of AN, in order to simplify the use of the table for each of the alternative sets of exposure limits. Second, the proposal includes a specific limitation on the use of respirators to comply with the permissible exposure limits. Such a limitation is consistent with the proposed hierarchy of exposure controls provided under paragraph (g) of the proposal. Third, the proposal requires that air-purifying respirators, where permitted by the proposal and the respirator table, be approved by NIOSH for use with AN, rather than generally approved for use with organic vapors, as provided in the ETS. Such specific approval will not be given by NIOSH unless the cartridges or canisters have an end-of-service-life indicator, since AN does not have a low enough odor threshold to permit detection of low level breakthrough by smell. OSHA requests information as to whether there are cartridges or canisters presently available specifically for AN which have such end-of-service-life indicators. In addition, OSHA is considering a provision similar to that in the ETS, permitting the use of cartridges or canisters if replaced before the end of their service life (where indicators exist), or at the beginning of each shift, whichever comes first. OSHA welcomes comments and testimony on the selection of appropriate respiratory protection, the proper limitations for the use of air-purifying respirators with AN, and other factors relevant to an effective respiratory protection program. In addition, OSHA also welcomes comments and testimony as to whether a quantitative fit test should be required wherever canister or cartridge respirators are to be used.

8. *Paragraph (n)—Medical surveillance.* The medical surveillance provisions of the proposed standard are substantially identical with those of the ETS. Both sets of provisions give particular emphasis to the central nervous system, the respiratory system and lower digestive tract. These represent the areas which the relevant animal studies and human epidemiological study indicate to be the major target sites for production of malignancy as a result of AN exposure. The

physical examination required in the proposed standard will be required annually for all AN-exposed employees. OSHA requests additional information on tests and analyses which may be helpful in the early diagnosis of cancer of the aforementioned systems of the body.

9. *Medical removal protection.* OSHA is seeking public input regarding the appropriateness of including a provision in the final AN standard which would protect employee participation in the medical surveillance program. This provision would extend economic protection to employees who participate in the medical surveillance program and are removed or transferred from their jobs to protect them from material impairment of health. The purpose of this provision would be to encourage employees to participate in the medical surveillance program, which is an important part of OSHA's multifaceted prophylactic approach to occupational health.

The medical surveillance provision of the proposed standard contemplates that employers will limit the exposure of employees who are at increased risk of material impairment of health. Improved engineering controls, work practices, hygiene practices, and respirators must be utilized to reduce employee exposures so that the employee is no longer at increased risk of material impairment of his or her health.

OSHA's primary goal is to assure that no employee suffers material impairment of health or functional capacity. The Agency does not favor transfer or removal as an alternative to controlling the level of a toxic substance in the workplace environment. Moreover, once full compliance with the permissible exposure limits is achieved by engineering controls and work practices, the need to transfer or remove employees from exposure to AN should arise infrequently.

However, it appears that limitation of exposure by transfer or removal of the employees from occupational exposure may, on occasion, be necessary to effectively protect employees from material impairment of health.

Therefore, OSHA is seeking public input as to whether the medical surveillance provisions of the AN standard should include a requirement for medical removal protection and the nature of such protection. This requirement could maintain the rate of pay, seniority, and other rights of an employee for the time period, or a portion thereof, that the employee is transferred or removed from his or her job as a result of an increased health risk from exposure to AN.

A more complete discussion of the various issues and options available in this proceeding regarding medical removal protection may be found in the OSHA proposed standard on occupational exposure to lead, published at 42 FR 46547 (September 16, 1977).

10. *Paragraph (g).—Recordkeeping.* The proposed standard requires the employer to keep written records of employee exposure measurements and medical examinations. Symptoms of cancer may not appear for many years after exposure to AN. Thus, records of exposure measurement and medical examinations should be retained for a definite period of years even if the employee ceases to work. For this reason, the recordkeeping provisions of the proposal require the employer to retain these records for at least 40 years, or for the duration of employment plus 20 years, whichever is longer.

## V. Technological Feasibility Assessment and Economic Impact Statement

In accordance with Executive Order 11949 (42 FR 1017), OSHA has contracted for a technological feasibility assessment and economic impact statement from Enviro Control, Inc., (ECI), of Rockville, Md. ECI is presently evaluating the economic impact of the proposed standard, with emphasis on the three alternative sets of permissible exposure limits set forth in paragraph (e) of the proposal.

When the final document has been prepared and reviewed, the Assistant Secretary will certify that the economic impact of the proposed standard on acrylonitrile has been evaluated in accordance with the Executive Order. When the document is available for inspection and copying, a notice of availability will be published in the Federal Register. OSHA invites comments on the technological feasibility and economic impact of the proposed standard.

## VI. Environmental Impact Assessment

The National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 et seq.) requires, among other things, that Federal agencies assess their proposed major actions, including proposed rulemaking, to determine whether a significant impact on the quality of the human environment may result. Further, pursuant to Department of Labor regulations [29 CFR Part 1999.3(a)], whenever OSHA is considering a major Federal action, the Director of the Office of Standards shall determine whether an environmental impact statement is required. If the Director determines that such an impact statement is not required, 29 CFR Part 1999.3(e) states that "he shall set forth in writing the decision and the reasons for it, which shall be available for public inspection." In keeping with these regulations, it has been determined that the proposed standard for occupational exposure to acrylonitrile (AN) does not require the preparation of an environmental impact statement because available evidence does not indicate that it will have any adverse environmental impact for the reasons set forth below:

1. The proposed standard is designed to control employees' exposures to AN within their work facilities, and it is this population which is expected to experience any health or environmental benefit, as outlined in earlier sections of this proposal.

2. Available evidence does not indicate the potential for significant environmental or health effects outside of the workplace environment resulting from this proposal. According to a source assessment of air emissions from acrylonitrile manufacturing operations, prepared by EPA, [Source Assessment: Acrylonitrole Manufacture (Air Emissions), EPA 800/2-76-032, March 1977], current uncontrolled levels of acrylonitrile emissions from monomer manufacturing plants are less than 0.1 ppm (maximum ground level concentration). No data currently exist which relate AN emissions from these manufacturing operations to health problems external to the workplace.

3. Since it is economically desirable to recycle recoverable AN monomer, there is every reason to believe that emissions will decrease (especially if reductions of employee exposure are achieved through increased monomer stripping), as the employer will be motivated to control and recycle any residuals. Reduction of the emission of any nonnaturally-occurring chemical may be considered a beneficial environmental impact. As discussed in paragraph No. 2 above, however, current emissions of AN are already so low that any further reduction will not result in any incremental benefit to the environment external to the workplace.

4. There is no evidence to indicate that the proposed standard will result in any significant change in water quality, solid waste disposal or land use external to the workplace.

5. Potential energy increases and economic impacts of this proposal will be discussed in the Technological Feasibility and Economic Impact Statement, prepared for OSHA by Enviro Control, Inc.

On the basis of the assessment presented above, and the discussion of the proposal presented earlier in this notice, OSHA has determined that the proposed regulation will not significantly adversely affect the quality of the human environment, and that preparation of an environmental impact statement is not required. If, during the period for public comment on this proposal, however, data are received which indicate that significant and quantifiable environmental impacts are likely to occur as a result of this proposal, OSHA reserves the right to reconsider its decision and to proceed with preparation of an environmental impact statement.

Written comments and information on the projected technological, economic, and environmental impacts of the proposed standard on acrylonitrile are solicited from any interested persons or groups during the period for

written comment submissions listed below in the notice.

VII. PUBLIC PARTICIPATION—NOTICE OF HEARING

Interested persons are invited to submit written data, views, and arguments with respect to the ETS and this proposed permanent standard. These comments must be postmarked on or before February 21, 1978, and submitted in quadruplicate to the Docket Officer, Docket No. H-108, U.S. Department of Labor, 3rd Street and Constitution Avenue NW., Room S6212, Washington, D.C. 20210. Written submissions must clearly identify the provisions of the ETS, the proposal, or both, which are addressed, and the positions taken with respect to each issue.

The data, view, and arguments that are submitted will be available for public inspection and copying at the above address. All timely written submissions received will be made a part of the record of this proceeding.

Pursuant to section 6(b)(3) of the Act, an opportunity to submit oral testimony concerning the issues raised by the ETS and the proposed standard, including the economic and environmental impacts, will be provided at an informal public hearing scheduled to begin at 9:30 a.m. on March 21, 1978, in the Auditorium, New Department of Labor Building, 3rd Street and Constitution Avenue NW., Washington, D.C. 20210.

*Notices of Intention to Appear.* All persons desiring to participate at the hearing must file, in quadruplicate, a notice of intention to appear, postmarked on or before February 27, 1978 with the OSHA Division of Consumer Affairs, Docket No. H-108, U.S. Department of Labor, 3rd Street and Constitution Avenue NW., Room N-3633, Washington, D.C. 20210, telephone 202-523-8024. The notices of intention to appear, which will be available for inspection and copying at the OSHA Technical Data Center—Docket Office (Room S6212), telephone 202-523-7894, must contain the following information:

1. The name, address, and telephone number of each person to appear;

2. The capacity in which the person will appear;

3. The approximate amount of time requested for the presentation;

4. The specific issues that will be addressed;

5. A detailed statement of the position that will be taken with respect to each issue addressed; and

6. Whether the party intends to submit documentary evidence, and if so, a brief summary of that evidence.

*Filing of Testimony and Evidence Before Hearing.* Any party requesting more than 15 minutes for a presentation at the hearing, or who will submit documentary evidence, must provide in quadruplicate the complete text of testimony, including any documentary evidence to be presented at the hearing, to the OSHA Division of Consumer Affairs. This material must be received by March 7, 1978, and will be available for inspection and copying at the Technical Data Center—Docket Office. Each such submission will be reviewed in light of the amount of time requested in the notice of intention to appear. In those instances where the information contained in the submission does not justify the amount of time requested, a more appropriate amount of time will be allocated and the participant will be notified of that fact.

Any party who has not substantially complied with the requirement to provide the complete text of testimony and documentary evidence may be limited to a 15 minute presentation, and may be requested to return for questioning at a later time.

*Conduct of Hearings.* The hearing will commence at 9:30 a.m. on Tuesday, March 21, 1978, with resolution of any procedural matters relating to the proceeding. The hearing will be conducted in accordance with 29 CFR Part 1911. In view of the ETS and its emergency nature, the hearing will be conducted in as expedited a manner as possible, consistent with a full development of the record and rights of the parties.

The hearing will be presided over by an Administrative Law Judge who will have all the powers necessary or appropriate to conduct a full and fair informal hearing as provided in 29 CFR Part 1911. Following the close of the hearing or of any post hearing comment period that might be provided, The Administrative Law Judge will certify the record to the Assistant Secretary of Labor for Occupational Safety and Health. The proposal will be reviewed in light of all oral and written submissions received as part of the record, and a standard will be issued based on the entire record in this proceeding.

VIII. AUTHORITY

This document was prepared under the direction of Eula Bingham, Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, Third Street and Consitiution Avenue NW., Washington, D.C. 20210.

Accordingly, pursuant to sections 4(b), 6(b), 6(c) and 8(c) of the Occupational Safety and Health Act of 1970 (84 Stat. 1592, 1593, 1596, 1599; 29 U.S.C. 653, 655, 657), the Secretary of Labor's Order No. 8-76 (41FR 25059), and 29 CFR Part 1911, it is hereby proposed to amend Part 1910 of Title 29 of the Code of Federal Regulations by amending section 1910.1045 as set forth below. In addition, pursuant to section 4(b)(2) of the Act (84 Stat. 1592; 29 U.S.C. 653), OSHA is of the view that the proposed standard is more effective than the corresponding standards now in Subpart B of Part 1910, in Parts 1915, 1916, 1917, 1918 and 1926 of Title 29 of the Code of Federal Regulations. Therefore, these corresponding standards would also be superseded by the new proposed standard.

Signed at Washington, D.C. this 12th day of January, 1978.

EULA BINGHAM,
*Assistant Secretary of Labor.*

Part 1910 of Title 29 of the Code of Federal Regulations is therefore proposed to be amended by revising § 1910.1045 to read as follows:

**§ 1910.1045 Acrylonitrile.**

(a) *Scope and application.* (1) This section applies to all occupational exposure to acrylonitrile (AN), Chemical Absracts Service Registry No. 000107131, except as provided in paragraph (a)(2) of this section.

(2) This section does not apply to the processing, use, and handling of products fabricated from polyacrylonitrile (PAN) where objective data is reasonably relied upon as to one of the following conditions:

(i) That the material to be processed is not capable of releasing AN resulting in airborne concentrations in excess of [1.0 ppm; or 0.5 ppm; or 0.1 ppm], under the expected conditions of processing, use and handling which will cause the greatest possible release; or

(ii) That the material to be processed is not a latex or other liquid mixture and does not contain more than (*XX*) ppm by weight, residual AN; or

(iii) That the material to be processed is not a latex or other liquid mixture and will not be heated or melted during the fabrication process.

Where the processing, use, and handling of products fabricated from PAN are exempted under this paragraph, the employer shall maintain records of the objective data supporting that exemption, as provided in paragraph (q) of this section.

(b) *Definitions:* "Acrylonitrile" or "AN" means acrylonitrile monomer, chemical formula CH2=CHCN.

"Action level" means a concentration of AN of [1 ppm; or 0.5 ppm; or 0.1 ppm] averaged over any eight (8)-hour period

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

"Authorized person" means any person specifically authorized by the employer whose duties require the person to enter a regulated area, or

any person entering such an area as a designated representative of employees for the purpose of exercising the opportunity to observe monitoring procedures under pargraph (r) of this section.

"Director" means the Director, National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare, or designee.

"Emergency" means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment, which is likely to, or does, result in unexpected exposure to AN in excess of the ceiling limit.

"OSHA Area Office" means the Area Office of the Occupational Safety and Health Administration having jurisdiction over the geographic area where the affected workplace is located.

"Polyacrylonitrile" or "PAN" means polyacrylonitrile homopolymers or copolymers, except for materials as exempted under paragraph (a)(2) of this section.

(c) *Permissible exposure limits.*—(1) *Inhalation.*—(i) *Time-weighted average limit (TWA).* The employer shall assure that no employee is exposed to an airborne concentration of acrylonitrile in excess of [two (2) parts; or one (1) part; or two-tenths (0.2) part] acrylonitrile per million parts of air [2 ppm; or 1 ppm; or 0.2 ppm], as an eight (8)-hour time-weighted average.

(ii) *Ceiling limit.* The employer shall assure that no employee is exposed to an airborne concentration of acrylonitrile in excess of [10 ppm; or 5 ppm; or 1 ppm] as averaged over any fifteen (15)-minute period during the working day.

(2) *Dermal and eye exposure.* The employer shall assure that no employee is exposed to skin contact or eye contact with liquid AN or PAN.

(d) *Notification of use and emergencies.*—(1) *Use.* Within ten (10) days of the effective date of this standard, or within fifteen (15) days following the introduction of AN into the workplace, every employer shall report, unless he has done so pursuant to the emergency temporary standard, the following information to the OSHA Area Office for each such workplace:

(i) The address and location of each workplace in which AN is present;

(ii) A brief description of each process of operation which may result in employee exposure to AN;

(iii) The number of employees engaged in each process or operation who may be exposed to AN and an estimate of the frequency and degree of exposure that occurs; and

(iv) A brief description of the employer's safety and health program as it relates to limitation of employee exposure to AN. Whenever there has been a significant change in the information required by this paragraph, the employer shall promptly amend such information previously provided to the OSHA Area Office.

(2) *Emergencies and remedial action.* Emergencies, and the facts obtainable at that time, shall be reported within twenty-four (24) hours of the initial occurrence to the OSHA Area Office. Upon request of the OSHA Area Office, the employer shall submit additional information in writing relevant to the nature and extent of employee exposures and measures taken to prevent future emergencies of a similar nature.

(e) *Exposure monitoring.*—(1) *General.* (i) Determinations of airborne exposure levels shall be made from air samples that are representative of each employee's exposure to AN over an eight (8)-hour period.

(ii) For the purposes of this section, employee exposure is that exposure which would occur if the employee were not using a respirator.

(2) *Initial monitoring.* Each employer who has a place of employment in which AN is present shall monitor each such workplace and work operation to accurately determine the airborne concentrations of AN to which employees may be exposed. Such monitoring may be done on a representative basis, provided that the determinations are representative of employee exposures.

(3) *Frequency.* (i) If the monitoring required by this section reveals employee exposure to be below the action level, the employer may discontinue monitoring for that employee.

(ii) If the monitoring required by this section reveals employee exposure to be at or above the action level but below the permissible exposure limits, the employer shall repeat such monitoring for each such employee at least quarterly.

(iii) If the monitoring required by this section reveals employee exposure to be in excess of the permissible exposure limits, the employer shall repeat these determinations for each such employee at least monthly. The employer shall continue these monthly measurements until at least two consecutive measurements, taken at least seven (7) days apart, are below the permissible exposure limits, and thereafter the employer shall monitor at least quarterly.

(4) *Additional monitoring.* Whenever there has been a production, process, control or personnel change which may result in new or additional exposures to AN, or whenever the employer has any other reason to suspect a change which may result in new or additional exposures to AN, additional monitoring which complies with this paragraph shall be conducted.

(5) *Employee notification.* (i) Within five (5) working days after the receipt of monitoring results, the employer shall notify each employee in writing of the results which represent that employee's exposure.

(ii) Whenever the results indicate that the representative employee exposure exceeds the permissible exposure limits, the employer shall include in the written notice a statement that the permissible exposure limits were exceeded and a description of the corrective action being taken to reduce exposure to or below the permissible exposure limits.

(6) *Accuracy of measurement.* The method of measurement of employee exposures shall be accurate, to a confidence level of 95 percent, to within plus or minus 25 percent for concentrations of AN at or above the permissible exposure limits, and plus or minus 35 percent for concentrations of AN between the action level and the permissible exposure limits.

(7) *Weekly survey of operations involving liquid AN.* In addition to monitoring of employee exposures to AN as otherwise required by this paragraph, the employer shall survey areas of operations involving liquid AN at least weekly to detect points where AN liquid or vapor are being released into the workplace. The survey shall employ an infra-red gas analyzer calibrated for AN, a multipoint gas chromatographic monitor, or comparable system for detection of AN. A listing of levels detected and areas of AN release, as determined from the survey, shall be posted prominently in the workplace, and shall remain posted until the next survey is completed.

(f) *Regulated areas.* (1) The employer shall establish regulated areas where AN concentrations are in excess of the permissible exposure limits.

(2) Regulated areas shall be demarcated and segregated from the rest of the workplace, in any manner that minimizes the number of persons who will be exposed to AN.

(3) Access to regulated areas shall be limited to authorized persons or to persons otherwise authorized by the Act or regulations issued pursuant thereto.

(4) The employer shall assure that in the regulated area, food or beverages are not present or consumed, smoking products are not present or used, and cosmetics are not applied, (except that these activities may be conducted in the lunchrooms, change rooms and showers required under paragraphs (m)(1)–(m)(3) of this section).

(g) *Methods of compliance.*—(1) *Engineering and work practice controls.* (i) The employer shall institute engineering or work practice controls to reduce and maintain employee exposures to AN, to or below the permissi-

ble exposure limits, except to the extent that the employer establishes that such controls are not feasible.

(ii) Wherever the engineering and work practice controls which can be instituted are not sufficient to reduce employee exposures to or below the permissible exposure limits, the employer shall nonetheless use them to reduce exposures to the lowest levels achievable by these controls and shall supplement them by the use of respiratory protection which complies with the requirements of paragraph (h) of this section.

(2) *Compliance program.* (i) The employer shall establish and implement a written program to reduce employee exposures to or below the permissible exposure limits solely by means of engineering and work practice controls, as required by paragraph (g)(1) of this section.

(ii) Written plans for these compliance programs shall include at least the following:

(A) A description of each operation or process resulting in employee exposure to AN above the permissible exposure limits;

(B) Engineering plans and other studies used to determine the controls for each process;

(C) A report of the technology considered in meeting the permissible exposure limits;

(D) A detailed schedule for the implementation of engineering or work practice controls; and

(E) Other relevant information.

(iii) Written plans for such a program shall be submitted upon request to the Assistant Secretary and the Director, and shall be available at the worksite for examination and copying by the Assistant Secretary, the Director, or any affected employee or representative.

(iv) The plans required by this paragraph shall be revised and updated at least every (6) six months to reflect the current status of the program.

(h) *Respiratory protection*—(1) *General.* The employer shall assure that respirators are used where required pursuant to this section to reduce employee exposure to within the permissible exposure limits and in emergencies. Compliance with the permissible exposure limits may not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement feasible engineering and work practice controls; or

(ii) In work operations such as maintenance and repair activities in which the employer establishes that engineering and work practice controls are not feasible; or

(iii) In work situations where feasible engineering and work practice controls are not yet sufficient to reduce exposure to or below the permissible exposure limits; or

(iv) In emergencies.

(2) *Respirator selection.* (i) Where respiratory protection is required under this section, the employer shall select and provide at no cost to the employee, the appropriate type of respirator from Table I below and shall assure that the employee wears the respirator provided.

TABLE I.—*Respiratory protection for acrylonitrile (AN)*

| *Concentration of AN or condition of use* | *Respirator type* |
|---|---|
| (a) Less than or equal to 10× permissible exposure limits. | (1) Any chemical cartridge respirator with organic vapor cartridge(s) and half-mask; or<br>(2) Any supplied air respirator with half-mask. |
| (b) Less than or equal to 50× permissible exposure limits | (1) Any organic vapor gas mask; or<br>(2) Any supplied air respirator with full facepiece; or<br>(3) Any self-contained breathing apparatus with full facepiece. |
| (c) Less than or equal to 2,000× permissible exposure limits. | (1) Supplied air respirator in positive pressure mode with full facepiece, helmet, hood, or suit. |
| (d) Less than or equal to 10,000× permissible exposure limits. | (1) Supplied air respirator and auxiliary self-contained full facepiece in positive pressure mode; or<br>(2) Open circuit self-contained breathing apparatus with full facepiece in positive pressure mode. |
| (e) Emergency entry into unknown concentration of firefighting. | (1) Any self-contained breathing apparatus with full facepiece in positive pressure mode. |
| (f) Escape | (1) Any organic vapor gas mask; or<br>(2) Any self-contained breathing apparatus with full facepiece. |

(ii) The employer shall select respirators from those approved for use with AN by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(3) *Respirator program.* (i) The employer shall institute a respiratory protection program in accordance with 29 CFR 1910.134 (b), (d), (e), and (f).

(ii) Where air-purifying respirators (chemical cartridge or canister-type gas mask) are used, the air-purifying canister or cartridge(s) shall be replaced prior to the expiration of their service life or at the beginning of each shift, whichever occurs first. A label shall be attached to the cartridge or canister to indicate the date and time at which it is first installed on the respirator.

(iii) The employer shall allow each employee who uses a filter respirator (cartridge or canister) to change the filter elements whenever an increase in breathing resistance is detected and shall maintain an adequate supply of the filter elements necessary for this purpose.

(iv) Employees who wear respirators shall be allowed to wash their faces and respirator facepieces to prevent potential skin irritation associated with respirator use.

(i) *Emergency situations*—(1) *Written plans.* (i) A written plan for emergency situations shall be developed for each workplace where AN is present. Appropriate portions of the plan shall be implemented in the event of an emergency.

(ii) The plan shall specifically provide that employees engaged in correcting emergency conditions shall be equipped as required in paragraph (h) of this section until the emergency is abated.

(2) *Alerting employees*—(i) *Alarms.* Where there is the possibility of employee exposure to AN in excess of the ceiling limit due to the occurrence of an emergency, a general alarm shall be installed and maintained to promptly alert employees of such occurrences.

(ii) *Evacuation.* Employees not engaged in correcting the emergency shall be restricted from the area and shall not be permitted to return until the emergency is abated.

(j) *Protective clothing and equipment*—(1) *Provision and use.* Where eye or skin contact with liquid AN or PAN may occur, the employer shall provide at no cost to the employee, and assure that employees wear, appropriate protective clothing or other equipment in accordance with §§ 1910.132 and 1910.133 to protect any area of the body which may come in contact with liquid AN or PAN.

(2) *Cleaning and replacement.* (i) The employer shall clean, launder, maintain, or replace protective clothing and equipment required by this paragraph, as needed to maintain their effectiveness. In addition, the employer shall provide clean protective clothing and equipment at least weekly to each affected employee.

(ii) The employer shall assure that the employee removes all protective clothing and equipment at the completion of a work shift and that an employee whose protective clothing becomes wet with liquid AN or PAN removes that clothing promptly to avoid skin contact with the liquid AN or PAN. Protective clothing shall be removed only in change rooms as required by paragraph (n)(1) of this section.

(iii) The employer shall assure that AN- or PAN-contaminated protective clothing and equipment is placed and stored in closable containers which prevent dispersion of the AN or PAN outside the container.

(iv) The employer shall assure that no employee removes AN- or PAN-contaminated protective equipment or

clothing from the change room, except for those employees authorized to do so for the purpose of laundering, maintenance, or disposal.

(v) The employer shall inform any person who launders or cleans AN- or PAN-contaminated protective clothing or equipment of the potentially harmful effects of exposure to AN.

(vi) The employer shall assure that containers of contaminated protective clothing and equipment which are to be removed from the workplace for any reason are labeled in accordance with paragraph (p)(3)(ii) of this section, and that such labels remain affixed when such containers leave the employer's workplace.

(k) *Housekeeping*—(1) *Surfaces.* (i) All surfaces shall be maintained free of accumulations of liquid AN and of PAN.

(ii) Dry sweeping and the use of compressed air for the cleaning of floors and other surfaces where liquid AN and PAN are found is prohibited.

(iii) Where vacuuming methods are selected, either portable units or a permanent system may be used.

(A) If a portable unit is selected, the exhaust shall be attached to the general workplace exhaust ventilation system or collected within the vacuum unit, equipped with high efficiency filters or other appropriate means of contaminant removal, so that AN is not reintroduced into the workplace air; and

(B) Portable vacuum units used to collect AN may not be used for other cleaning purposes and shall be labeled as prescribed by paragraph (p)(3)(ii) of this section.

(iv) Cleaning of floors and other contaminated surfaces may not be performed by washing down with a hose, unless a fine spray has first been laid down.

(2) *Liquids.* Where AN is present in a liquid form, or as a resultant vapor, all containers or vessels containing AN shall be enclosed to the maximum extent feasible and tightly covered when not in use, with adequate provision made to avoid any resulting potential explosion hazard.

(l) *Waste disposal.* AN and PAN waste, scrap, debris, bags, containers or equipment, shall be disposed of in sealed bags or other closed containers which prevent dispersion of AN outside the container, and labeled as prescribed in paragraph (p)(3)(ii) of this section.

(m) *Hygiene facilities and practices.* Where employees are exposed to airborne concentrations of AN above the permissible exposure limits, or where employees are required to wear protective clothing or equipment pursuant to paragraph (k) of this section, or where otherwise found to be appropriate, the facilities required by 29 CFR 1910.141 shall be provided by the employer for the use of those employees, and the employer shall assure that the employees use the facilities provided. In addition, the following facilities or requirements are mandated.

(1) *Change rooms.* The employer shall provide clean change rooms in accordance with 29 CFR 1910.141(e).

(2) *Showers.* (i) The employer shall provide shower facilities in accordance with 29 CFR 1910.141(d)(3).

(ii) In addition, the employer shall also assure that employees exposed to liquid AN and PAN shower at the end of the work shift.

(3) *Lunchrooms.* (i) Whenever food or beverages are consumed in the workplace, the employer shall provide lunchroom facilities which have a temperature controlled, positive pressure, filtered air supply, and which are readily accessible to employees exposed to AN above the permissible exposure limits.

(ii) In addition, the employer shall also assure that employees exposed to AN above the permissible exposure limits wash their hands and face prior to eating.

(n) *Medical Surveillance.*—(1) *General.* (i) The employer shall institute a program of medical surveillance for each employee who is or will be exposed to AN above the action level. The employer shall provide each such employee with an opportunity for medical examinations and tests in accordance with this paragraph.

(ii) The employer shall assure that all medical examinations and procedures are performed by or under the supervision of a licensed physician, and shall be provided without cost to the employee.

(2) *Initial examinations.* At the time of initial assignment, or upon institution of the medical surveillance program, the employer shall provide each affected employee an opportunity for a medical examination, including at least the following elements:

(i) A work history and medical, history with special attention to skin, respiratory, and gastrointestinal systems, and those non-specific symptoms, such as headache, nausea, vomiting, dizziness, weakness, or other central nervous system dysfunctions that may be associated with acute or chronic exposure to AN.

(ii) A physical examination giving particular attention to central nervous system, gastrointestinal system, respiratory system, skin and thyroid.

(iii) A 14" x 17" posteroanterior chest x-ray.

(iv) Further tests of the intestinal tract, including fecal occult blood and proctosigmoidoscopy, on all workers 40 years of age or older, and to any other affected employees for whom, in the opinion of the physician, such testing would be appropriate.

(3) *Periodic examinations.* (i) The employer shall provide examinations specified in this paragraph at least annually for all employees specified in paragraph (n)(1) of this section.

(ii) If an employee has not had the examinations prescribed in paragraph (n)(2) of this section within 6 months of termination of employment, the employer shall make such examination available to the employee upon such termination.

(4) *Additional examinations.* If the employee for any reason develops signs or symptoms commonly associated with exposure to AN, the employer shall provide appropriate examination and emergency medical treatment.

(5) *Information provided to the physician.* The employer shall provide the following information to the examining physician:

(i) A copy of this standard and its appendices;

(ii) A description of the affected employee's duties as they relate to the employee's exposure;

(iii) The employee's representative exposure level;

(iv) The employee's anticipated or estimated exposure level (for preplacement examinations or in cases of exposure due to an emergency);

(v) A description of any personal protective equipment used or to be used; and

(vi) Information from previous medical examinations of the affected employee, which is not otherwise available to the examining physician.

(6) *Physician's written opinion.* (i) The employer shall obtain a written opinion from the examining physician which shall include:

(A) The results of the medical tests performed;

(B) The physician's opinion as to whether the employee has any detected medical condition which would place the employee at an increased risk of material impairment of the employee's health from exposure to AN;

(C) Any recommended limitations upon the employee's exposure to AN or upon the use of protective clothing and equipment such as respirators; and

(D) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

(ii) The employer shall intruct the physician not to reveal in the written opinion specific findings or diagnoses unrelated to occupational exposure to AN.

(iii) The employer shall provide a copy of the written opinion to the affected employee.

(o) *Employee information and training.*—(1) *Training program.* (i) The employer shall institute a training program for all employees where there is occupational exposure to AN and

shall assure their participation in the training program.

(ii) The training program shall be provided at the time of initial assignment, or upon institution of the training program, and at least annually thereafter, and the employer shall assure that each employee is informed of the following:

(A) The information contained in Appendices A, B and C;

(B) The quantity, location, manner of use, release or storage of AN and the specific nature of operations which could result in exposure to AN, as well as any necessary protective steps;

(C) The purpose, proper use, and limitations of respirators;

(D) The purpose and a description of the medical surveillance program required by paragraph (n) of this section:

(E) The emergency procedures developed, as required by paragraph (i) of this section; and

(F) The engineering and work practice controls, their function and the employee's relationship thereto; and

(G) A review of this standard.

(2) *Access to training materials.* (i) The employer shall make a copy of this standard and its appendices readily available to all affected employees.

(ii) The employer shall provide, upon request, all materials relating to the employee information and training program to the Assistant Secretary and the Director.

(p) *Signs and labels.*—(1) *General.* (i) The employer may use labels or signs required by other statutes, regulations, or ordinances in addition to, or in combination with, signs and labels required by this paragraph.

(ii) The employer shall assure that no statement appears on or near any sign or label, required by this paragraph, which contradicts or detracts from such effects of the required sign or label.

(2) *Signs.* (i) The employer shall post signs to clearly indicate all workplaces where AN concentrations exceed the permissible exposure limits. The signs shall bear the following legend:

DANGER

ACRYLONITRILE (AN)

CANCER HAZARD

AUTHORIZED PERSONNEL ONLY

RESPIRATORS REQUIRED

(ii) The employer shall assure that signs required by this paragraph are illuminated and cleaned as necessary so that the legend is readily visible.

(3) *Labels.* (i) The employer shall assure that precautionary labels are affixed to all containers of AN, and to containers of PAN and products fabricated from PAN, except for those materials for which objective data is provided as to the conditions specified in paragraph (a) (2) of this section. The employer shall assure that the labels remain affixed when the AN or PAN are sold, distributed or otherwise leave the employer's workplace.

(ii) The employer shall assure that the precautionary labels required by this paragraph are readily visible and legible. The labels shall bear the following legend:

DANGER

CONTAINS ACRYLONITRILE (AN)

CANCER HAZARD

(q) *Recordkeeping.*—(1) *Objective data for exempted operations.* (i) Where the processing, use, and handling of products fabricated from PAN are exempted pursuant to paragraph (a)(2) of this section, the employer shall establish and maintain an accurate record of objective data reasonably relied upon in support of the exemption.

(ii) This record shall include the following information:

(A) The relevant condition in paragraph (a)(2) upon which exemption is based;

(B) The source of the objective data;

(C) The results of testing and analysis of the material being processed;

(D) A description of the operation exempted; and

(E) Other data relevant to the operations, materials, and processing covered by the exemption.

(iii) The employer shall maintain this record for the duration of the employer's reliance upon such objective data.

(2) *Exposure monitoring.* (i) The employer shall establish and maintain an accurate record of all monitoring required by paragraph (e) of this section.

(ii) This record shall include:

(A) The dates, number, duration, and results of each of the samples taken, including a description of the sampling procedure used to determine representative employee exposure;

(B) A description of the sampling and analytical methods used;

(C) Type of respiratory protective devices worn, if any; and

(D) Name, social security number and job classification of the employee monitored and of all other employees whose exposure the measurement is intended to represent.

(iii) The employer shall maintain this record for at least 40 years or the duration of employment plus 20 years, whichever is longer.

(3) *Medical surveillance.* (i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance as required by paragraph (n) of this section.

(ii) This record shall include:

(A) A copy of the physicians' written opinions;

(B) any employee medical complaints related to exposure to AN;

(C) A copy of the information provided to the physician as required by paragraph (n) (6) of this section; and

(D) A copy of the employee's work history.

(iii) The employer shall assure that this record be maintained for at least forty (40) years, or for the duration of employment plus twenty (20) years, whichever is longer.

(4) *Availability.* (i) The employer shall assure that all records required to be maintained by this section be made available upon request to the Assistant Secretary and the Director for examination and copying.

(ii) The employer shall assure that employee exposure measurement records, as required by this section, be made available, upon request, for examination and copying to the affected employee, former employee, or designated representative.

(iii) The employer shall assure that employee medical records required to be maintained by this section, be made available, upon request, for examination and copying, to the affected employee or former employee, or to a physician designated by the affected employee, former employee, or designated representative.

(5) *Transfer of records.* (i) Whenever the employer ceases to do business, the successor employer shall receive and retain all records required to be maintained by this section.

(ii) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, these records shall be transmitted to the Director.

(iii) At the expiration of the retention period for the records required to be maintained pursuant to this section, the employer shall transmit these records to the Director.

(r) *Observation of monitoring.*—(1) *Employee observation.* The employer shall provide affected employees, or their designated representatives, an opportunity to observe any monitoring of employee exposure to AN conducted pursuant to paragraph (e) of this section.

(2) *Observation procedures.* (i) Whenever observation of the monitoring of employee exposure to AN requires entry into an area where the use of protective clothing or equipment is required, the employer shall provide the observer with personal protective clothing or equipment required to be worn by employees working in the area, assure the use of such clothing and equipment, and require the observer to comply with all other applicable safety and health procedures.

(ii) Without interfering with the monitoring, observers shall be entitled:

(A) To receive an explanation of the measurement procedures;

(B) To observe all steps related to the measurement of airborne concentrations of AN performed at the place of exposure; and

(C) To record the results obtained.

(s) *Effective date.* This section shall become effective thirty (30) days following publication.

(t) *Appendices.* The information contained in the appendices is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligation.

APPENDIX A.—SUBSTANCE SAFETY DATA SHEET FOR ACRYLONITRILE

I. SUBSTANCE IDENTIFICATION

A. Substance: Acrylonitrile ($CH_2=CHCN$).

B. Synonyms: Propenenitrile; vinyl cyanide; cyanoethylene; AN; VCN; acrylon; carbacryl; fumigrain; ventox.

C. Acrylonitrile can be found as a liquid or vapor, and can also be found in polymer resins, plastics, polyols, and other polymers having acrylonitrile as a raw or intermediate material.

D. AN is used in the manufacture of acrylic and modacrylic fibers, acrylic plastics and resins, specialty polymers, nitrile rubbers, and other organic chemicals. It has also been used as a fumigant.

E. Appearance and Odor: Colorless to pale yellow liquid with a pungent odor which can only be detected at concentrations above the permissible exposure level, in a range of 13–19 parts AN per million parts of air (13–19 ppm).

F. Permissible Exposure: Exposure may not exceed either:

1. [*Two parts;* or *one part;* or *two-tenths part*] AN per million parts of air [*2 ppm;* or *1 ppm,* or *0.2 ppm*] averaged over the eight-hour workday; or

2. [*Ten parts;* or *five parts;* or *one part*] AN per million parts of air [*10 ppm;* or *5 ppm;* or *1 ppm*] averaged over any 15-minute period in the workday.

3. In addition, skin and eye contact with liquid AN is prohibited.

II. HEALTH HAZARD DATA

A. Acrylonitrile can affect your body if you inhale the vapor (breathing), if it comes in contact with your eyes or skin, or if you swallow it. It may enter your body through your skin.

B. Effects of Overexposure:

1. Short-term Exposure: Acrylonitrile can cause eye irritation, nausea, vomiting, headache, sneezing, weakness, and light-headedness. At high concentrations, the effects of exposure may go on to loss of consciousness and death. When acrylonitrile is held in contact with the skin after being absorbed into shoe leather or clothing, it may produce blisters following several hours of no apparent effect. Unless the shoes or clothing are removed immediately and the area washed, blistering will occur. Usually there is no pain or inflammation associated with blister formation.

2. Long-term Exposure: Acrylonitrile has been shown to cause cancer in laboratory animals and has been associated with higher incidences of cancer in humans. Repeated or prolonged exposure of the skin to acrylonitrile may produce irritation and dermatitis.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are caused by exposure to acrylonitrile.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If acrylonitrile gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If acrylonitrile gets on your skin, immediately wash the contaminated skin with water. If acrylonitrile soaks through your clothing, especially your shoes, remove the clothing immediately and wash the skin with water. If symptoms occur after washing, get medical attention immediately. Thoroughly was the clothing before re-using. Contaminated leather shoes or other leather articles should be discarded.

C. Inhalation: If you or any other person breathes in large amounts of acrylonitrile, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

D. Swallowing: When acrylonitrile has been swallowed, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

E. Rescue: Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the location of the emergency equipment before the need arises.

F. Special First Aid Procedures: First aid kits containing an adequate supply (at least two dozen) of amyl nitrite pearls, each containing 0.3 ml, should be maintained at each site where acrylonitrile is used. When a person is suspected of receiving an overexposure to acrylonitrile, immediately remove that person from the contaminated area using established rescue procedures. Contaminated clothing must be removed and the acrylonitrile washed from the skin immediately. Artificial respiration should be started at once if breathing has stopped. If the person is unconscious, amyl nitrite may be used as an antidote by a properly trained individual in accordance with established emergency procedures. Medical aid should be obtained immediately.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: You may be required to wear a respirator for non-routine activities, in emergencies, and while your employer is in the process of reducing acrylonitrile exposures through engineering controls. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required.

Acrylonitrile does not have a detectable odor except at levels above the permissible exposure limit. Do not depend on odor to warn you when a respirator cartridge or canister is exhausted. Cartridges or canisters must be changed daily or before the end-of-service-life, whichever comes first. Re-use of these may allow acrylonitrile to gradually filter through the cartridge and cause exposures which you cannot detect by odor. If you can smell acrylonitrile while wearing a respirator, proceed immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Supplied-air Suits: In some work situations, the wearing of supplied-air suits may be necessary. Your employer must instruct you in their proper use and operation.

C. Replace or repair impervious clothing that has developed leaks. Protective Clothing: You must wear impervious clothing, gloves, face shield, or other appropriate protective clothing to prevent skin contact with liquid acrylonitrile. Where protective clothing is required, your employer is required to provide clean garments to you weekly.

Acrylonitrile should never be allowed to remain on the skin. Clothing and shoes should not be allowed to become contaminated with acrylonitrile, and if they do, the clothing should be promptly removed and laundered or discarded and placed in appropriately labeled containers and the shoes should be discarded. Once acrylonitrile penetrates shoe leather or other leather articles, they should not be worn again.

D. Eye Protection: You must wear splash-proof safety goggles in areas where liquid acrylonitrile may contact your eyes. In addition, contact lenses should not be worn in areas where eye contact with acrylonitrile can occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

A. Acrylonitrile is a flammable liquid and its vapors can easily form explosive mixtures in air.

B. Acrylonitrile must be stored in tightly-closed containers in a cool, well-ventilated area, away from heat, sparks, flames, strong oxidizers (especially bromine), strong bases, copper, copper alloys, ammonia, and amines.

C. Sources of ignition such as smoking and open flames are prohibited wherever acrylonitrile is handled, used, or stored in a manner that could create a potential fire or explosion hazard.

D. You should use non-sparking tools when opening or closing metal containers of acrylonitrile, and containers must be bonded and grounded when pouring or transferring liquid acrylonitrile.

E. You must immediately remove any non-impervious clothing that becomes contaminated with acrylonitrile, and this clothing must not be reworn until the acrylonitrile is removed from the clothing.

F. Clothing wet with liquid acrylonitrile can be easily ignited. You must promptly remove this clothing, and it must not be reworn until the acrylonitrile is removed from the clothing.

G. If your skin becomes wet with liquid acrylonitrile, you must promptly and thoroughly wash or shower with soap or mild detergent to remove any acrylonitrile from your skin.

H. You must not keep food, beverages, or smoking materials in areas where acrylonitrile is handled, processed, or stored, nor are you permitted to eat or smoke in these areas.

I. If you handle acrylonitrile, you must wash your hands thoroughly with soap or

mild detergent and water before eating, smoking, or using toilet facilities.

J. Fire extinguishers and quick drenching facilities must be readily available, and you should know where they are and how to operate them.

K. Ask your supervisor where acrylonitrile is used in your work area and for any additional plant safety and health rules.

VI. ACCESS TO INFORMATION

A. Each year, your employer is required to inform you of the information contained in this Substance Safety Data Sheet for acrylonitrile. In addition, your employer must instruct you in the proper work-practices for using acrylonitrile, emergency procedures, and the correct use of protective equipment.

B. Your employer is required to determine whether you are being exposed to acrylonitrile. You or your representative has the right to observe employee measurements and to record the results obtained. Your employer is required to inform you of your exposure. If your employer determines that you are being overexposed, he or she is required to inform you of the actions which are being taken to reduce your exposure to within permissible exposure limits.

C. Your employer is required to keep records of your exposures and medical examinations. These records must be kept by the employer for at least forty (40) years or for the period of your employment plus twenty (20) years. whichever is longer.

D. Your employer is required to release exposure and medical records to your physician upon your written request.

APPENDIX B—SUBSTANCE TECHNICAL GUIDELINES FOR ACRYLONITRILE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: AN; VCN; vinyl cyanide; propenenitrile; cyanoethylene; Acrylon; Carbacryl; Fumigrain; Ventox.

2. Formula: $CH_2=CHCN$.

3. Molecular Weight: 53.1

B. Physical Data.

1. Boiling Point (760 mm Hg.): 77.3° C (171° F).

2. Specific Gravity (water=1): 0.81 (at 20° C or 68° F).

3. Vapor Density (air=1 at boiling point of acrylonitrile): 1.83.

4. Melting Point: −83° C (−117° F).

5. Vapor Pressure at 20° F: 83 mm Hg.

6. Solubility in Water, percent by weight at 20° C (68° F): 7.35.

7. Evaporation Rate (Butyl Acetate=1): 4.54.

8. Appearance and Odor: Colorless to pale yellow liquid with a pungent odor at concentrations above the permissible exposure level. Any detectable odor of acrylonitrile may indicate overexposure.

II. FIRE, EXPLOSION, AND REACTIVITY HAZARD DATA

A. Fire.

1. Flash Point: −1° C (30° F) (closed cup).

2. Autoignition Temperature: 481° C. (898° F).

3. Flammable limits air, percent by volume: Lower: 3, Upper: 17.

4. Extinguishing media: Alcohol foam, carbon dioxide, dry chemical.

5. Special fire-fighting procedures: Do not use a solid stream of water, since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.

6. Unusual fire and explosion hazards: Acrylonitrile is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where acrylonitrile is handled, used, or stored in a manner that could create a potential fire or explosion hazard. Acrylonitrile vapors are heavier than air and may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which acrylonitrile is being handled.

7. For purposes of compliance with the requirements of 29 CFR 1910.106, acrylonitrile is classified as a Class IB flammable liquid. For example, 7500 ppm, approximately one-fourth of the lower flammable limit, would be considered to pose a potential fire and explosion hazard.

8. For purposes of compliance with 29 CFR 1910.157, acrylonitrile is classified as a Class B fire hazard.

9. For purposes of compliance with 29 CFR 1910.309, locations classified as hazardous due to the presence of acrylonitrile shall be Class I, Group D.

B. Reactivity:

1. Conditions contributing to instability: Acrylonitrile will polymerize when hot, and the additional heat liberated by the polymerization may cause containers to explode. Pure AN may self-polymerize, with a rapid build-up of pressure, resulting in an explosion hazards. Inhibitors are added to the commercial product to prevent self-polymerization;

2. Incompatibilities: Contact with strong oxidizers (especially bromine) and strong bases may cause fires and explosions. Contact with copper, copper alloys, ammonia, and amines may start serious decomposition.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen cyanide, oxides of nitrogen, and carbon monoxide) may be released in a fire involving acrylonitrile and certain polymers made from acrylonitrile.

4. Special precautions: Liquid acrylonitrile will attack some forms of plastics, rubbers, and coatings. Acrylonitrile monomer should be checked at least weekly to determine inhibitor content.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If acrylonitrile is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. The area should be evacuated at once and re-entered only after thorough ventilation.

3. If liquid acrylonitrile, collect for reclamation or absorb in paper, vermiculite, dry sand, earth, or similar material.

4. If acrylonitrile polymer, collect spilled material in the most convenient and safe manner for reclamation or for disposal.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until clean-up has been completed.

C. Waste disposal methods: Waste material shall be disposed of in a manner that is not hazardous to employees or to the general population. Spills of acrylonitrile and flushing or such spills shall be channeled for appropriate treatment or collection for disposal. They shall not be channeled directly into the sanitary sewer system. Containers of AN and PAN wastes shall be appropriately labeled. In selecting the method of waste disposal, applicable local, state, and federal regulations should be consulted.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. Exposure above the Permissible Exposure Limit:

1. Eight-hour exposure evaluation: Measurements taken for the purpose of determining employee exposure under this section are best taken so that the average eight-hour exposure may be determined from a single 8-hour sample or two (2) 4-hour samples. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee.)

2. Ceiling evaluation: Measurements taken for the purpose of determining employee exposure under this section must be taken during periods of maximum expected airborne concentrations of acrylonitrile in the employee's breathing zone. A minimum of three (3) measurements should be taken on one work shift. The highest of all measurements taken is an estimate of the employee's ceiling exposure.

3. Monitoring techniques: The sampling and analysis under this section may be performed by collecting the acrylonitrile vapor on charcoal absorption tubes or other composition absorption tubes, with subsequent chemical analysis. Sampling and analysis may also be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, or passive dosimeters, as well as by gas and vapor absorption tubes. The method of measurement chosen should determine airborne acrylonitrile levels to an accuracy of plus or minus 25% for concentrations at or above the permissible exposure limits, and plus or minus 35% for concentrations at or above the action level but below the permissible exposure limits. Analysis of resultant samples should be by gas chromatograph.

4. Survey of operations. At least on a weekly basis, the employer shall use a direct-reading instrument, such as a portable infra-red analyzer, or equivalent point-monitoring system, to survey all operations involving liquid AN or PAN to determine points at which AN vapor or liquid may be released into the workplace. A listing of points monitored, together with levels of acrylonitrile detected, if any, shall be prepared from this survey, and the listing shall be displayed prominently in the workplace. As an alternative survey method, grab samples, utilizing vapor collection bags, with subsequent gas chromatographic analysis, can be used.

B. Since many of the duties relating to employee exposure are dependent on the results of monitoring and measuring procedures, employers shall assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. PROTECTIVE CLOTHING

Employees shall be provided with and required to wear appropriate protective clothing to prevent any possibility of skin contact with liquid AN or PAN. Because acrylonitrile is absorbed through the skin, it is important to prevent skin contact with liquid AN or PAN. Protective clothing shall include impermeable coveralls or similar full-body work clothing, gloves, head-coverings, as appropriate to protect areas of the body which may come in contact with liquid AN or PAN.

Employers should ascertain that the protective garments are impermeable to acry-

lonitrile. Non-impermeable clothing and shoes should not be allowed to become contaminated with liquid AN and PAN. If permeable clothing does become contaminated, it should be promptly removed and not worn again until completely free of the material. If leather footwear or other leather garments become wet from acrylonitrile, they should be replaced and not worn again, due to the ability of leather to absorb acrylonitrile and hold it against the skin. Since there is no pain associated with the blistering, it is essential that the employee be informed of this hazard so that he or she can be protected.

Any protective clothing which has developed leaks or is otherwise found to be defective shall be repaired or replaced. Clean protective clothing shall be provided to the employee at least weekly, and whenever the clothing becomes wet with liquid AN or PAN. Employees are also required to wear splash-proof safety goggles where there is any possibility of acrylonitrile contacting the eyes.

#### VI. HOUSEKEEPING AND HYGIENE FACILITIES

For purposes of complying with 29 CFR 1910.141, the following items should be emphasized:

A. The workplace should be kept clean, orderly, and in a sanitary condition;

B. Dry sweeping and the use of compressed air is unsafe for the cleaning of floors and other surfaces where liquid AN or PAN may be found.

C. Adequate washing facilities with hot and cold water should be provided, and maintained in a sanitary condition. Suitable cleansing agents should also be provided to assure the effective removal of acrylonitrile from the skin.

D. Change or dressing rooms with individual clothes storage facilities should be provided to prevent the contamination of street clothes with acrylonitrile. Because of the hazardous nature of acrylonitrile, contaminated protective clothing should be stored in closed containers for cleaning or disposal.

#### VII. MISCELLANEOUS PRECAUTIONS

A. Store acrylonitrile in tightly-closed containers in a cool, well-ventilated area, and take necessary precautions to avoid any explosion hazard.

B. High exposures to acrylonitrile can occur when transferring the liquid from one container to another.

C. Non-sparking tools must be used to open and close metal acrylonitrile containers. These containers must be effectively grounded and bonded prior to pouring.

D. Never store uninhibited acrylonitrile. The inhibitor content shall be determined weekly.

E. Acrylonitrile vapors are not inhibited. They may form polymers and clog vents of storage tanks.

F. Use of supplied-air suits or other impervious coverings may be necessary to prevent skin contact with and provide respiratory protection from acroylonitrile where the concentration of acrylonitrile is unknown or is above the ceiling limit. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life-endangering characteristics of supplied-air suits.

G. Employers shall advise employees of all areas and operations where exposure to acrylonitrile could occur.

#### VII. COMMON OPERATIONS

Common operations in which exposure to acrylonitrile is likely to occur include the following: manufacture of the acroylonitrile monomer; synthesis of acrylic fibers, ABS and SAN plastics and resins, nitrile rubber, surface coatings, specialty chemicals, use as a chemical intermediate, use as a fumigant and in the cyanoethylation of cotton.

### APPENDIX C—MEDICAL SURVEILLANCE GUIDELINES FOR ACRYLONITRILE

#### I. ROUTE OF ENTRY

Inhalation; skin absorption; ingestion.

#### II. TOXICOLOGY

Acrylonitrile vapor is an asphyxiant due to inhibitory action on metabolic enyzme systems. Animals exposed to 75 or 100 ppm for 7 hours have shown signs of anoxia; in some animals which died at the higher level, cyanomethemoglobin was found in the blood. Two human fatalities from accidental poisoning have been reported; one was caused by inhalation of an unknown concentration of the vapor, and the other was thought to be caused by skin absorption or inhalation. Most cases of intoxication from industrial exposure have been mild, with rapid onset of eye irritation, headache, sneezing, and nausea. Weakness, lightheadedness, and vomiting may also occur. Exposure to high concentrations may produce profound weakness, asphyxia, and death. The vapor is a severe eye irritant. Prolonged skin contact with the liquid may result in absorption with systemic effects, and in the formation of large blisters after a latent period of several hours. Although there is usually little or no pain or inflammation, the affected skin resembles a second-degree thermal burn. Solutions spilled on exposed skin, or on areas covered only by a light layer of clothing, evaporate rapidly, leaving no irritation, or, at the most, mild transient redness. Repeated spills on exposed skin may result in dermatitis due to solvent effects.

Results after one year of a planned two-year animal study on the effects of exposure to acrylonitrile have indicated that rats ingesting as little as 35 ppm in their drinking water develop tumors of the central nervous system. The interim results of this study have been supported by a similar study being conducted by the same laboratory, involving exposure of rats by inhalation of acrylonitrile vapor, which has shown similar types of tumors in animals exposed to 80 ppm.

In addition, the preliminary results of an epidemiological study being performed by duPont on a cohort of workers in their Camden, South Carolina acrylic fiber plant indicate a statistically significant increase in the incidence of colon and lung cancers among employees exposed to acrylonitrile.

#### III. SIGNS AND SYMPTOMS OF ACUTE OVEREXPOSURE

Asphyxia and death can occur from exposure to high concentrations of acrylonitrile. Symptoms of overexposure include eye irritation, headache, sneezing, nausea and vomiting, weakness, and light-headedness. Prolonged skin contact can cause blisters on the skin with the appearance of a second degree burn, but with little or no pain. Repeated skin contact may produce scaling dermatitis.

#### IV. TREATMENT OF ACUTE OVEREXPOSURE

Remove employee from exposure. Immediately flush eyes with water and wash skin with soap or mild detergent and water. If AN has been swallowed, and person is conscious, induce vomiting. Give artificial resuscitation if indicated. More severe cases, such as those associated with loss of consciousness, may be treated by the intravenous administration of sodium nitrite, followed by sodium thiosulfate, although this is not as effective for acrylonitrile poisoning as for inorganic cyanide poisoning.

#### V. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. As noted above, exposure to acrylonitrile has been linked to increased incidence of cancers of the colon and lung in employees of the duPont acrylic fiber plant in Camden, S.C. In addition, the animal testing of acrylonitrile has resulted in the development of cancers of the central nervous system in rats exposed by either inhalation or ingestion. The physician should be aware of the findings of these studies in evaluating the health of employees exposed to acrylonitrile.

Most reported acute effects of occupational exposure to acrylonitrile are due to its ability to cause tissue anoxia and asphyxia. The effects are similar to those caused by hydrogen cyanide. Liquid acrylonitrile can be absorbed through the skin upon prolonged contact. The liquid readily penetrates leather, and will produce burns of the feet if footwear contaminated with acrylonitrile is not removed.

It is important for the physician to become familiar with the operating conditions in which exposure to acrylonitrile may occur. Those employees with skin diseases may not tolerate the wearing of whatever protective clothing may be necessary to protect them from exposure. In addition, those with chronic respiratory disease may not tolerate the wearing of negative-pressure respirators.

B. Sureveillance and screening.

Medical histories and laboratory examinations are required for each employee subject to exposure to acrylonitrile above the action level. The employer must screen employees for history of certain medical conditions which might place the employee at increased risk from exposure.

1. *Central nervous system dysfunction.* Acute effects of exposure to acrylonitrile generally involve the central nervous system. Symptoms of acrylonitrile exposure include headache, nausea, dizziness, and general weakness. The animal studies cited above suggest possible carcinogenic effects of acrylonitrile on the central nervous system, since rats exposed by either inhalation or ingestion have developed similar CNS tumors.

2. *Respiratory disease.* The duPont data indicate an increased risk of lung cancer among employees exposed to acrylonitrile.

3. *Gastrointestinal disease.* The duPont data indicate an increased risk of cancer of the colon among employees exposed to acrylonitrile. In addition, the animal studies show possible tumor production in the stomachs of the rats in the ingestion study.

4. *Skin disease.* Acrylonitrile can cause skin burns when prolonged skin contact with the liquid occurs. In addition, repeated skin contact with the liquid can cause dermatitis.

5 *General.* The purpose of the medical procedures outlined in the standard is to es-

tablish a baseline for future health monitoring. Persons unusually susceptible to the effects of anoxia or those with anemia would be expected to be at increased risk. In addition to emphasis on the CNS, respiratory and gastro-intestinal systems, the cardiovascular system, liver, and kidney function should also be stressed.

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